THE UNIVERSITY OF ALBERTA

A TRACK AND FIELD HEXATHLON FOR HIGH SCHOOL BOYS

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Track and Field Hexathlon for High School Boys" submitted by Larrie Allan Grant in partial fulfilment of the requirements for the degree of Master of Arts.

ABSTRACT

The principal objective of this study was to develop a comparative achievement scale based on six track and field events in the Okanagan area of British Columbia. The events chosen were the shot put and discus throw; 100 yard sprint and 880 yard run; and high jump and long jump.

The test sample was selected at random from the physical education classes of the area. Results were obtained from sixteen schools and 1,183 boys, tested during their regular physical education classes. Classification of results was by age as of June 1. Normative and comparative tables were calculated for high school boys, ages thirteen to eighteen inclusive.

Testing was carried out by the physical education teachers following a standardized procedure. Data was then received and converted for use on the IBM 360 computer at the University of Alberta. Mean and standard deviations were obtained for each event and each age group.

Hexathlon tables were produced for each age group involving a transformation to standard score form. This transformation was to T-scores which are defined as having a mean of fifty and a standard deviation of ten. These same tables could be used to form individual profile charts depicting the relative achievement in track and field.

Percentile tables were also produced to facilitate the interpretation of relative position of any result in

one of the selected events. Percentile tables were given for each event with a separate table for each of the age groups, thirteen to eighteen inclusive.

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TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

LIST OF FIGURES

CHAPTER I

STATEMENT OF THE PROBLEM

I. INTRODUCTION

Track and field events are some of the basic motor performance skills and form a part of the physical education curriculum at nearly all age levels, and in nearly all parts of the world. The competitive approach to the fundamental skills of running and jumping has been found in all ancient civilizations. One example of this approach is the athletic programs of the ancient Greeks. The Olympic decathlon, as an event, would have developed from the Greek pankration as described by Harris (24).

Competition forms an integral part of all athletic programs but is not always an actual contest in even basic motor skills. Standards of time or distance are frequently used in place of an actual contest as a basis of competition at all ability levels. An achievement scale, based on performance, provides the individual or teacher with a method of comparing performance and/or indicating improvement.

The concept of "physical fitness" is of particular concern to all physical educators. In Canada, percentile norms for boys and girls, age seven to seventeen, have been established for the CAHPER FITNESS PERFORMANCE TEST (6). Similarly, since 1958 in the United States the results of the AAHPER YOUTH FITNESS TEST (1) have made available

country-wide percentile norms of achievement in fundamental measures of physical fitness. Results of both tests give norms for the motor skills of running and jumping. The athlete in track and field who trains at a variety of events was assumed to have a higher level of motor fitness which overlaps into a general concept of physical fitness (10). Since physical fitness is listed as the first objective of physical education in all Canadian Provinces, it would seem that, for a physical education class, more emphasis should be placed on a combination of events in track and field rather than specialization in a single event.

Specific studies should be carried out in specific geographic areas, so that norms could be developed, which are based on the more representative population and which would take local bias or specialization into consideration. Then, comparisons can be made, first between individuals who are homogeneously grouped and second, between one area and another, or one area and a larger area or country. Some studies which have been limited to a specific geographic area are (8)(13)(16)(39)(40)(43)(44) and (50). According to Kenyon (28) normative studies tend to level out performance if the norms are established on too broad a sample.

Up to the present time, norms or achievement scales based on boys' physical education classes in the Okanagan Valley of British Columbia have never been attempted. Physical education, specifically the extramural program is highly organized by the physical education teachers of this

area. The Okanagan Valley Schools' Athletic Association, (OVSAA), organizes competitions in many different sports for both boys and girls. Track and field forms an integral part of this inter-school competition and an achievement scale in track and field would be a worthwhile addition to the physical education program of the region.

II. THE PROBLEM

Statement of the Problem

The purpose of this study is to establish an achievement scale for selected track and field events based on performance in boys' physical education classes for grades eight through twelve in the Okanagan area of British Columbia.

Subsidiary Problems

Although the primary purpose of the study is to produce comparitive scores the available information provides an opportunity to study certain subsidiary problems that are as follows:

(1) Establish percentile norms of performance for each age group for each event.

(2) Establish an individual profile chart for achievement in track and field events.

(3) Examine the relationship between performance and age in track and field events.

Limitations

The primary limitation of this study is the stan-

dardization of the measuring and recording of results by a large number of physical education teachers. Standardization is also difficult in that facilities of sixteen schools are being utilized and these may differ. The variability of the jumping pits and grass track conditions may also have an influence on performance.

The results of this study may only be applied to the population of Okanagan high school boys, ages thirteen to eighteen, from which the sample was drawn. 1183 subjects are drawn by means of a random cluster technique (45). Once a class is selected, all members are tested except those who are absent or excused because of a physical defect or a condition which is of such a nature as to affect his performance. Physical education is a required course in three out of four of the high school years, with some of the schools offering physical education in grades eight, nine, ten, and eleven while others have their classes in eight, nine, ten, and twelve. Since the results of this study are intended for use in the physical education class and because all testing is done during class time, no attempt is made to evaluate boys not enrolled in a regular physical education class.

Only six events; two track and four field events, are chosen. No inference may be made towards other track and field events.

Age groups are considered only if a minimum of one hundred subjects are available for the sample. This results

in a set of standards for ages thirteen to eighteen only.

Some schools situated in the population area are not interested sufficiently in the study or are unable to participate and therefore are excluded from the sample choices.

A further limitation to this study is the statistical treatment and the assumptions followed. The performance achievement of the population is assumed to be normally distributed and the samples scores, therefore, transformed to a normal standard score distribution.

III. JUSTIFICATION OF THE STUDY

Importance to the Teachers

Many physical education teachers are vitally concerned with pupil development and adjustment which result from activity. Measurement is necessary if the extent of child development is to be known. Often teachers now judge pupil achievement and progress largely subjectively. If they are to proceed scientifically, they must utilize scientific procedures.

Most physical education teachers now use achievement or performance scales of various types as a teaching and motivating aid for track and field classes. Tables are constructed on what the teacher thinks the individual should be able to do or what individuals have done for this teacher in the past. These opinions are subject to question and directly depend on the experience of the

teacher. The performance scales which result from this study will be made available to all physical education teachers and schools in the area. At the present time there are no normative achievement scales in any topic in this geographic area.

Achievement scales of performance can be used:

To Motivate. A student is motivated by the scale to improve his own rating, either by working more diligently in class time or by practicing on his own. The purpose of an achievement scale is to help the student interpret his performance. Both the poor athlete and the good athlete can see exactly how much further he must jump, how much further he must throw, or how much faster he must run, in order to improve his rating. Then he can be in competition with himself as well as with others.

To Evaluate. In British Columbia the physical education teacher is required to give a letter grade in physical education. This letter grade is based, in part, on performance in certain fundamental skills and the overall improvement of performance. For a track and field unit the achievement scale would provide the teacher with a more accurate and valid result on which to make this appraisal.

To Compare. Comparisons of achievement in track and field are most often made by direct competition. The faster or better trained runner is usually the winner of a race between two boys. It is not always practical to hold direct competition and therefore measurements of time or

distance are substituted. A test score by itself is quite meaningless. Only when it is known how the test score relates to scores made by others can the performance, represented by the scores, be interpreted. The fundamental concept of a standardized achievement scale is that scores in relatively dissimilar test items can be compared; for example, what performance in the 100 yard dash is equivalent to a throw of 86 feet in the discus for a particular age group? These tables, based on standard deviation units, will give this information. In addition to comparison of individuals and events, these tables, on a longitudinal basis, will show improvement or decline of one individual's performance over a period of years. Classes or schools may be compared using the same methods as for individuals if mean scores are used. Achievement tests may be given prior to, and following, a course of instruction or different methods of instruction, for the purpose of determining the amount of progress made in the intervening time. The school norms may be compared with the Okanagan norms or the Okanagan norms may be compared with similar results in other parts of the world.

To Select. The track and field coach will find these percentile ratings a help in the selection of personnel for his track squad or for the selection of events for an individual who is good in many. Both the teacher and the student will find such a scale useful in the diagnosis of strengths and weaknesses of performance and to select

further areas of training.

As An Event. The hexathlon, or a modification, could be a valuable part of any good intramural program as a separate event. In intramurals, points could be awarded to every member of any competitional unit who achieves a certain standard in each event. Possibly these tables could become the origin for the inclusion of a multi-contest event, as a separate event, in the inter-school track meets.

IV. JUSTIFICATION OF THE EVENTS CHOSEN

The selection criterion was based on the concept that the events chosen must be as representative as possible, of the events that would normally be taught in a high school physical education class in the Okanagan. Some events were not chosen because of expected difficulties in administration of the event or standardization of measurement in the event. Another factor that was considered was that the events should be common events, found in most school systems so that certain comparisons could be made if the teacher wished

It was decided to take two events from each of the three major categories of running, jumping, and throwing. The six events chosen for this study are the 100 yard dash and the 880 yard run; the running high jump and the running long jump; the shot put and the discus throw. Although it is not practical to measure performances in all events, eventually tables for other events could be added

to those contained in this study.

Prior to the final selection of events the physical education teachers were asked to express their opinions. (See Appendix A.) Nine teachers answered the survey and general agreement was reached on the following six events.

The 100 yard sprint was selected as an event representative of the standard sprint race. Shorter distances are not always considered as events in a track program. The longer sprints would have to be administered on a curved or oval track. The 100 yard run is primarily a measure of speed with the influence of endurance minimized.

The 880 yard run was selected as an event that combines speed and endurance. It is a standard distance in most track programs. This event was chosen over the mile as a more suitable event for the physical education class since it is less time consuming to measure. Motivation would not be as important a factor and therefore results should be more reliable than those obtained in a longer event such as the mile or two mile runs.

The running long jump was selected as an event since it is a less complex skill than the triple jump and a more representative event than the standing long jump. Most subjects who are good at the triple jump are also good in the long jump. It was decided to modify the long jump to measure true jumping ability rather than the ability to hit the take-off board. The take-off area was enlarged to thirty inches and the jump measured from take-off to landing.

The shot-put and discus throwing events have been selected as the throwing events as they are the two most often performed in a physical education class. Although most schools have the eight pound shot, it was decided to use the four kilogram shot so that the results would be meaningful in the future. The Okanagan has just adapted the four kilogram shot and the one kilogram discus as the official implements in these respective events. All age groups are to put the same shot even though the older students would use heavier weights in inter-school competition.

Seven of the nine teachers answering the survey requested modification in the discus throwing event. The thirteen, fourteen, and fifteen year old boys are to throw the one kilogram discus (2 pounds, 3.224 ounces), while the sixteen, seventeen, and eighteen year old boys are to throw the intermediate discus (three pounds, nine ounces).

V. DEFINITION OF TERMS

Decathlon-Type Scoring Table. A decathlon-type scoring table is a set of standards of times or distances. It is comparable to the tables used to score the decathlon event in international track and field. Points are awarded for performance in relation to standards of achievement in each event.

Hexathlon Scoring Table. A hexathlon scoring table is a decathlon-type scoring table or achievement scale based on performance in relation to standards in six events. Points

are awarded for performance in relation to these standards in each event for each age group. The maximum number of points per event is 100. The awarded point values are comparable from one event to another.

T-Scores or T-Scales. The T-scale is a means of converting raw scores on different tests into comparable values. This scale is best understood as a modification of the standard deviation units in the distribution. It is based upon a comparison of scores in terms of distances from the mean as measured in standard deviations. In the T-scale, the mean is expressed as fifty and each standard deviation above or below the mean adds or subtracts ten points. The normal curve extends three standard deviations in each direction from the mean. By assigning ten T-scores to each standard deviation, the scale must then range from approximately twenty to eighty.

Norms. A norm is a standard with which the score obtained in a test may be compared. Norms are used to interpret test scores in relation to the expected results usually in relation to the mean performance of a large sample or population. To be statistically correct, norms are only applicable to samples of the same population from which they were computed.

Percentiles or Percentile Ranks. The percentile scale shows the position of an individual in a group on the basis of that portion of the group that he exceeds. Percentiles cover the range from zero to one hundred. In

this study the percentile scale has been transformed to a normal distribution by setting the median equal to the mean and naming this score the 50th percentile. A score on the 60th percentile is the point on the normal curve below which 60 percent of the scores fall.

Age. The age of a participant is given in years as of June 1, 1967.

Okanagan. The Okanagan is the geographic area of the south east interior of British Columbia that is organized by the Okanagan Valley Schools Athletic Association. It stretches approximately from Kamloops to Osoyoos and includes Merritt and Keremeos.

Complete Gymnasium Uniform. As a minimum requirement for participation in all events, a participant is required to wear a complete gymnasium uniform consisting of tennis type shoes, shorts, and a shirt. Specific instructions for each event will be found in the test manual contained in the Appendix.

One-Hundred Yard Sprint. A 100 yard dash is a track event of one hundred yards distance which is run in a straight line. The score is given to the nearest tenth of a second. Two trials will be allowed and the best time recorded. One straight line is drawn from start to finish and two boys run simultaneously, one on each side of the line. All trials are administered on a grass surface.

Half-Mile Run. A 880 yard run or half-mile run is a track event run on grass surface around a rectangular

220 yard track. The event is run in groups of six to twenty with time recorded to the nearest second. Two trials are allowed and the best time is recorded.

Running Long Jump. The running long jump is a field event consisting of a running approach, a one-foot take-off, a flight through the air and a two-foot landing. The individual's longest jump from take-off to landing is measured to the nearest inch. The take-off area is thirty inches wide. All jumps are measured from the front of the take-off to the nearest break in the landing area made by any part of the body.

Running High Jump. The running high jump is a field event consisting of a running approach, a one foot take-off and a flight over a horizontal bar. Displacing the bar from its supports shall count as a failure. An individual is eliminated after three successive failures. No passes are allowed. The best jump is measured in inches as the vertical height at the center of the cross-bar from ground level to the top edge of the bar.

Shot-Put. A shot put is a weight throwing event in which a shot weighing four kilograms (8 pounds, 13 ounces) plus or minus one ounce and having a diameter of between 95 millimeters and 110 millimeters is put from within a circle which has a diameter of seven feet. The best distance of three throws is measured through the center of the throwing circle in a straight line with the point of impact with the ground, from the front edge of

the circle to the point of impact. Only legal puts were measured.

Discus. Throwing the discus is a weight throwing event in which a discus is thrown from a circle having a diameter of eight feet two and one half inches. The thirteen, fourteen, and fifteen year old boys throw a discus weighing one kilogram (2 pounds 3.274 ounces) plus or minus one ounce. The sixteen, seventeen, and eighteen year olds throw a discus weighing three pounds, nine ounces, plus or minus one ounce. The best distance of three throws is measured through the center of the throwing circle in a straight line with the point of impact with the ground, from the front edge of the circle to the point of impact. Measurement is to the nearest inch.

CHAPTER II

REVIEW OF THE LITERATURE

I. EVALUATION AND MEASUREMENT IN PHYSICAL EDUCATION

The purposes of evaluation and measurement are not always clearly understood. Evaluation is a process that can serve many purposes. Measurement, (upon which evaluation is based), makes use of many tools, such as tests, to determine the placement, or relative position of students. Measurement is necessary if one is to know the extent of pupil development and the extent to which the objectives of the program have been met. Bovard (5) sees the growth or progress in knowledge in physical education paralleling the growing scientific interest of teachers towards problems of the profession. The concept that further progress can be made only by means of increased knowledge of scientific procedures has little by little pervaded the entire professional atmosphere.

> Measurement must unquestionably be grouped in the category of scientific procedures essential to continued professional progress. (5:14)

Scientific measurement in physical education; the accuracy, validity, and reliability of testing, have all changed significantly, as physical education has developed as an academic discipline with a body of knowledge worthy of study.

History of Measurement in Physical Education

The first type of testing or evaluation attempted in physical education was anthropometric measurement. Attempts were made to predict athletic ability through the study of anthropometry and the significance of the relative proportions of the human body (5). On the theory that exercise should be prescribed to effect muscle size, emphasis was placed on body symmetry and proportion. In 1861 Hitchcock and later Sargent (10), prepared profile charts to indicate how individuals compare with certain standards.

Later, emphasis was shifted from the size and build to what one could do with one's body. The stress then shifted to strength tests, primarily through the pioneer work of Sargent; and cardiovascular efficiency with the utilization of the erograph in 1884 by Mosso (5).

A number of factors led to the decline of the strength tests and the development of an interest in the ability to handle the body in running, jumping, and throwing. In the early 1900's in the United States, various comprehensive tests were administered in the school systems. "From 1913 onward a great wave of testing in physical education gradually swept the country." (5) The next major step in physical education measurement came with the development of indices for measuring physical efficiency. One of the first indices devised was the McCloy's Classification Index (27), which is still used today. The concern over

physical fitness was instigated by the Kraus-Weber tests of minimum physical fitness. The results of these tests in the 1950's prompted President Eisenhower to call a conference on fitness of American youth on July 2, 1956 (40). One of the results of this conference was the AAHPER physical fitness test which was developed two years later. Canadian researchers have produced nation-wide norms for the CAHPER fitness-performance test (6) and are currently working on work capacity norms (7).

No attempt has been made here to trace the development of all aspects of measurement in physical education. Many important areas have been omitted completely. Bovard and Cozens have summed up the early measurement as follows:

> Measurement in physical education is not a new idea. The historical survey shows that the thoughtful teacher has been endeavouring to rate pupils and measure their progress for a long time. Some of this measurement has been objective, some has been observational, but until about 1925, practically all of it had been more or less unscientific. The achievement standards formerly set up were largely empirical the result of what experienced people in the field thought pupils should be able to do.(5:14).

Until recently the use of inadequate statistical methods prevented the construction of scientific measuring devices.

Brace (5) pioneered the use of standards or achievement scales in his application of a T-scale technique with basketball and soccer skills.

In 1913, the Playground and Recreation Association of America put in an Athletic Badge Test (5) with the idea of raising the standard of physical efficiency. For boys,

the test battery represented the four elements of all-around skill:

(1) arm strength, (2) jumping (3) speed in running, and (4) accuracy or strength, in throwing.

At the same time Stecher devised the "Philadelphia Public School Age Arm Chart" (5) which was based on norms of performance in certain physical skills for both boys and girls.

Many studies followed which were based on collected data and which were used to scale performance in a particular situation. McCloy and Reilley made separate and unique contributions to total concept of achievement scale rating.

McCloy devised a different statistical treatment when he established the Universal Scoring Tables (31)(32).

> The Universal Scoring tables have been devised so that the number of points assigned to a performance correspond to the amount of power, relative to the performer and the implement used. (32:38)

The theory underlying this type of scoring table is that the closer a performance approaches the world's record, the more difficult it is for the performer to increase his record. A performer can, for example, improve his record in the 100 yard dash from 16 seconds to 15 seconds much more easily than he can improve it from 11 seconds to 10 seconds. Routledge (39) used a modified version of this method in producing the Athletic Standard Pentathlon Scoring Table for Boys and Girls in Edmonton Public Secondary Schools.

In 1917 Reilly (5) established a classification known

as the Age-Grade-Height-Weight-Plan. To make competition equal, he designed a system of exponents that were to be used with actual performance measures to give a fairer method of comparison. This method has since been refined by McCloy (32) and Cozens (5) in separate methods.

In 1935 Cozens, Cubberly and Neilson (11) produced a book which gave achievement scales for high school girls and women in practically every aspect of physical education including, physical fitness, motor performance and sport skills.

Recent Studies

Since 1950 many normative studies have been produced specifically with regard to achievement in track and field in particular geographic areas (these were usually a high school or group of schools in an area).

In 1959 and again in 1963 Routledge (39)(40) has reported on extensive normative work for the students of Edmonton schools. In the first study, norms were established for the AAHPER Youth Fitness Test. The test battery was administered to 5692 boys by 59 teachers. Classification of boys was by age as well as age-height-weight classifications, with percentile norms established for each group. The same author has produced an Athletic Standard Pentathlon and a series of crest awards for boys and girls of the Edmonton schools. Classification was by age and points were awarded for performance of time or distance in the following events; 100 yards, 880 yards, high jump and long jump, as

well as the 8 pound shot-put event for boys and a softball throw for girls. One table was drawn up with standards of point achievement available for each age group. Crests were awarded to those of each age group passing the minimum standard.

In 1966 Fairbanks (16) conducted a similar study and established percentile norms for five track and field events for Edmonton boys. He classified by age and by the Cozens, Trieb-Neilson Classification Index for the 100 yard dash, the mile run, the 8 pound shot, the running high jump and the running long jump.

The tests were administered by 37 teachers to 2941 boys (90% of the total population of students enrolled in physical education) in their regular physical education classes.

The shapes of the distributions were examined and found to vary therefore supporting the use of percentile norms. Interesting subproblems that were discussed involved the difference of running on grass or cinder tracks, the O'Brien method versus orthodox methods of putting the shot and the various styles of high jumping. However, a recommendation was made that similar studies be conducted in other areas because of their value to the physical educators of the area.

II. THE DEVELOPMENT OF ACHIEVEMENT SCALES

Introduction

The purpose of an achievement scale is to help the

student interpret his performance. Therefore, he should understand the actual scale and the point values and understand his own changes in status as they occur. A scale computed on a class of high school girls would have little or no value for high school boys. Achievement scales are specific to a given group or class and should be motivating to students. Understandability and recognition of improvement are important in this respect.

Bovard (5) in his book "The Status of Measurement in Physical Education" outlines the historical development of athletic scoring scales. He suggests that until recently (1957) the chief criticism leveled at scoring schemes was that they were constructed arbitrarily and without regard to the actual performance of students. Use of appropriate statistical techniques has resulted in there being made available an increasing number of scientifically constructed achievement tests and scoring scales.

Neilson (37) summarizes the development of achievement scales by pointing out the contributions made by the public schools using as examples, the work of the City of Detroit, Stecher, the California Decathlon, Reilly and McCurdy.

Cozens, Cubberly and Neilson (11) have summed up the purposes of achievement scales for both the teacher and the student:

> The ways in which achievement scales can be used to advantage.
> A. Achievement scales may be used by the teacher.
> 1. In determining whether or not students

are making progress in the acquisition of skills in a particular activity.

2. In diagnosing strengths or weaknesses in the elements of team games or in all-round ability.

3. In classifying students into homogeneous groups for purposes of instruction.

4. In choosing tentative membership on teams so that teams will be more evenly matched.

5. In providing a partial method of rating each student in a given activity.

6. In offering to the instructor a means of evaluating her own technique of teaching, that is, in measuring the results of her own teaching methods.

7. In providing a scientific tool for research and experimentation in the field.

B. To the student, achievement scales are advantageous:

1. In offering a fair evaluation of her efforts in various phases of an activity at any given time.

2. In showing the rate of progress and improvement she is making over a particular period of time.

3. In serving as a motivating device, that is, in demonstrating the necessity for practice in fundamentals where weaknesses are shown.

4. In offering a device by which the student may immediately determine her ability in relation to the group with which she is associated.

Scott (41) also adds:

> It is not intended that such scales should serve as the only basis for grades but they could be used on a partial basis. The main purpose of achievement progression charts is to provide a means for individuals to progress without having to wait for the slowest student in the class.

III. CLASSIFICATION

The proper grouping of students in physical education activities has been a concern for many years. At first, weight was used but this soon led to a consideration of one or more of the factors of age, grade, height and weight.

McCloy (32) developed the formula 20 x age + 6 x height + weight as a better method of classification of

pupils.

In 1935 Cozens, Trieb, and Neilson (11) produced a different index for secondary school boys. 2 x age + .475 x height + .16 x weight. It was adapted in 1935 by the California Interscholastic Federation (8). This index resulted from the calculation of a best-fit index from the performance of twenty-thousand boys in a wide variety of individual athletic events.

Theoretically, the computation of a classification index using the factors of age, height and weight involves the solution of a four-variable problem in partial and multiple correlation techniques. This should also be expanded to have a separate classification for each age and each event. It would obviously be impractical to administer. The Neilson and Cozens classifying method and McCloy's Classification Index correlate .983, indicating that either one may be used for high school groups with equal satisfaction (30).

Age, height and weight were not entirely adequate as a basis for classification of pupils for participation in motor activities. Chronological age is only an approximation of maturational age. Even though the correlation between weight and strength is high, weight does not necessarily denote strength. McCloy (32) suggested that this may be partly due to "wide variations in ability to contract muscular tissue": that is, some persons are able to utilize a larger proportion of their muscle fibers in contraction at the same time than are other persons. He

suggested that some classification according to body build might be more useful. However, he later added:

> In spite of their limitations, age, height, and weight are, because of their convenience, and because of their high coefficients of correlation with valid criteria, decidedly useful for classifying persons for competitive sports.(32).

McCloy (32) also reported that if one were dealing with averages of the performance of large numbers of boys, there was a definite increase in performance scores, and from ages twelve to sixteen years, inclusive, almost a linear relationship.

Fleishman (18), in an extensive study of more than twenty thousand students established national norms for certain basic components of physical fitness. His classification according to age only, indicated that "size indices leave much to be desired and may introduce more error than correction." Within age groups, height and weight may correlate positively with one performance test and negatively with another and probably be uncorrelated with most. He has worked out the correlations between height and weight scores on each test.

Gross and Casciani (22) in 1962, after exhaustive statistical analysis, concluded that current indexes, composed of height, weight, and age have little value as classification for the AAHPER tests. In 1963 Espenschade, (15) after evaluating various statistical combinations of age, height, and weight concluded " . . . use of age alone as a basis for the development of test norms." In a recent

study, Fairbanks (16) recommended, for practical reasons, for the average physical education teacher "that age be retained as the basis for grouping high school students for track and field." Finally, a recent survey of the teachers of the Okanagan indicated that only two out of approximately thirty used any other method than age or grade in classifying students for physical education testing.

Most physical education teachers were inclined to group the students by grade in evaluation situations. Price (38), in setting up a fitness decathlon, agreed that there was no absolutely fair way to classify boys.

> Since men in the business world must compete on equal terms against each other, whether each opponent is older, heavier, or taller it seems reasonable that boys in the same grade compete on equal terms. Dropping the exponent grouping at Haverford brought no appreciable difference in the number of boys winning their decathlon award.

IV. SAMPLING AND NORMS

The problem so often faced by the teacher who wishes to use test norms is that the pupils of concern to them are not part of the standardized group. Unless they can be considered a part of such a population, the table of norms cannot be used. Ahman and Gloch (2) emphasized this problem.

> The sampling problem pertinent to test norms has been vastly underestimated. Tables of norms that are labeled "national" norms or "regional" norms without bothering to specify the manner in which the nation or region is sampled are contributing by omission to the fuzzy notion that the worth of a sample is determined only indirectly by the method of obtaining it. More often than not, the size of the sample is

> impressive and is noted with pride, notwithstanding the fact that the size of a sample is incidental to the method of selecting its members.

Kenyon (28) also stressed the need for local norms and pointed out the difference between a norm and a standard.

> While the national norms are a valuable addition to test information, particularly for inter region, inter system comparisons they cannot take the place of local scales carefully developed over several years using large numbers of pupils . . . . A norm is merely descriptive of the present status and that a standard is indicative of a desired level of achievement. If the norms for a test describe a level of achievement that is well below the potentialities of the group concerned and if the quality in question is thought to be a desirable one, a score at the 90th percentile may represent only mediocre performance.

In outlining the value of norm charts Clark (10) followed five main guide lines:

1. Sampling procedures for the construction of norms should be based on a wide distribution of the population.
2. The testing sample should be representative of the population for which the test is intended.
3. Norms should be used for the specific groups for which they are prepared.
4. The normality of each test item should be known before norm charts are constructed.
5. Norms for standard tests should be based upon a relatively large number of cases.

Some techniques used by other authors have solved the sampling problem by attempting to test the entire population (16). Random selection (13) (39) or a randomly selected cluster sample (1) (6) (18) are other methods of determining a statistically sound sample.

V. STATISTICAL TREATMENT

Most achievement tables have utilized a percentile score or some form of standardized score based on the mean

and standard deviation units. Others (34, 41) recommend the use of a standardized T-scale. This method assumes a normal distribution of results. The literature indicates that certain types of test data were not normally distributed in specific populations. Ehrlich (14) found that, when male freshman students at a single institution were tested on the 100 yard dash, their scores were positively skewed. Fairbanks (16) reported that performance scores were negatively skewed in the 100 yard dash and one mile events, with only slight negative skewness in the high jump and long jump events and a normal distribution for the eight pound shot with a shift from positive to negative skewness with increasing age.

Fleishman (18) found a normal distribution in most test items including a 600 yard run. Cozens (5) and associates recognized this problem in the construction of their achievement scales and corrected the process of establishing norms when data were found to depart from normality.

McCloy (31) employed the regression technique when taking the shape of the distribution into consideration while constructing the Universal Scoring Tables. He used an exponential factor based on the relationship of the score and the existing world record. Routledge (39) followed this method in his construction of Edmonton pentathlon tables.

Wotruba (50) instituted a different method of indicating scores in a decathlon table. For example, scores

were given for times in the 100 meters as the following:

> times between 13 and 16 seconds give 25 points and add 12 points per tenth.

Despite the number of different methods used, most researchers have used the T-scale system for establishing points scores on achievement scales (11) (34) (41). The T-scale is best understood as a modification of the standard deviation units in the distribution. On a scale of 0-100 T-scores may be obtained with a distribution of a mean of 50 and a standard deviation of 10. Massey (34) summarized the advantages of T-score scales as:

1. T-scores have all the advantages of comparability but are easier to manipulate than other types.
2. T-scores are easily understood by the student and conform more nearly to the traditional concept of the meaning of a mark.
3. T-scores, unlike percentiles scores, do not place emphasis upon comparisons between individuals. In percentiles 50% of the class is below a theoretically understood "failure" mark and may become discouraged.
4. T-scores usually range between 20 and 80 ($\pm$ 3 standard deviations).

> To those enamoured with statistical niceties such a situation is disturbing. To those primarily consumed with the practical use of test results for guidance and motivation such a condition is welcome. The T-score is never so low that the child believes he has no ability or no chance for improvement; correspondingly, never is a score so large that a child feels unduly superior and holds that part of the physical education program in contempt.

The T-scale has some clear limitations and weaknesses in the treatment of certain distributions. The T-scale was constructed to have five standard deviations above and below the mean. The lower and upper limits of this scale are often impossible to use. Mathews (35) when

discussing a study pointed out one obvious weakness.

> . . . we cannot use the lower end of the scale as it is impossible to score a negative number of sit-ups. Likewise a junior high school pupil would find it extremely difficult to score 68 sit-ups in two minutes, which is necessary to earn 100 points on the T-scale.

Scott and French (41) strongly recommend the use of T-scores and gave easily followed instructions for computation of T-scores using either raw scores or percentile scores. Their arguments are summed up in the following paragraph:

> From the standpoint of the teacher or test administrator, another advantage of the T-score is the ease with which a composite score may be obtained; T-scores may be added to obtain a single score for a series of measures. Those persons familiar with the use of a regression equation for combining scores will be interested in knowing that the sum of T-scores leaves relative standings almost unchanged if the weightings of the respective tests are almost equal. Correlations by the authors on such comparisons range from .94 to .98.

VI. DECATHLON AS AN EVENT

The decathlon is a test of skill in a variety or combination of track and field events. At the present time the Olympic decathlon events are the 100 meters, 400 meters, 1500 meters, 110 meter high hurdles, long jump, pole vault, high jump, shot put, discus and javelin. Each contestant competes in the same 10 events against set standards of time and distance. Points are awarded for performance, in relation to these standards in each event. The contestant accumulating the largest number of points in the 10 events is declared the winner.

Decathlon scoring tables were revised in 1962.

This latest revision resulted in relatively fewer points being awarded to the outstanding performance in a single event. Emphasis was placed on better-than-average performance in all events.

VII. SUMMARY

The growth of evaluation in physical education has been aided by the increased applications of scientific principles. Tests and measurements play a very important part in the evaluation, motivation and diagnosis of a good physical education program.

The method of classification of students will be by age with classes selected at random from those available.

T-scales will be constructed as the comparative scoring tables for the six event hexathlon. The modification of the basic decathlon into the Okanagan Hexathlon gives the teacher and his students a more practical and often fairer picture of each pupil's achievement, progress and relative standing. The scale is intended for the average student in the average physical education class.

It is hoped that the methods and procedures outlined in the following chapter will be considered accurate enough and precise enough to give valid, objective and reliable results and at the same time, satisfy the more practical minded teacher who must be able to understand and use the results.

CHAPTER III

METHODS AND PROCEDURES

I. APPROVAL OF THE PROJECT IN THE SCHOOLS

Approval for the project was obtained in two ways. The Okanagan Valley Schools Athletic Association, representing the physical education teachers of the area, was approached to determine their interest and the extent of the cooperation that could be expected. This approval was obtained by attending a meeting of the individuals concerned. Established lines of communication were then followed to obtain the official permission that was required. (See Appendix A.) This approval was obtained by letter from the Superintendents and Principals concerned.

Testing was carried out by twenty male physical education teachers on 1183 male students enrolled in physical education classes in sixteen Okanagan schools.

II. SAMPLING TECHNIQUE

The random cluster technique was used to obtain the required sample. The population was considered to be the male students enrolled in physical education classes at any of the sixteen schools in the Okanagan in the 1966-67 school year. A physical education class was considered as a unit of the population and was then chosen at random until a minimum of one hundred individuals were

obtained in each age group. Classes were selected according to a table of random numbers.

III. SELECTION OF EVENTS

It was decided to measure the performance of each boy in two events from each of the following fundamental activities in athletics. Discussion of other events and reasons for each choice were explained in the first chapter.

1. Running: The events chosen were 100 yards and 880 yards.

2. Jumping: The events chosen were the running high jump and a modified running long jump.

3. Throwing: The events chosen were the four kilogram shot-put and discus throw. (See Chapter One, Definitions, for a description.)

IV. CLASSIFICATION

Classification of the boys was to be by age in years as of June 1, 1967. Physical education teachers registered the age on the test recording form.

V. STANDARDIZATION OF RESULTS

The magnitude and scope of the study made it necessary that most of the measurement be done by the physical education teachers in the schools. It was not considered practical for one person to attempt to test over one thousand students in sixteen schools. The following steps were taken to make the results as standard as possible. Individual schools were given the opportunity of not par-

ticipating in the study during the initial meeting. While this may have weakened the sampling inferences it was felt that those remaining expressed a genuine desire to cooperate fully in the rest of the study. At this first meeting preliminary instructions were given. It was also stressed that because of the need of standardization, all instructions must be followed explicitly.

The next step was to mail a complete instructional booklet (see Appendix B) to each of the teachers involved in this study. Scoring cards and printed instructions were given to all testers. Prior to testing, each school was contacted to clear up any questions or misunderstandings. As problems arose the author assisted the teacher wherever possible and in some cases took charge of the testing itself.

Calibration of Instruments

The teachers were instructed to check all instruments prior to use in testing. All stop watches used by the testers contained dial markings of one-tenth of a second. Watches were checked for accuracy by comparison with another watch. Watches were not used if any differences occurred.

The shots and discus were weighed on a government certified scale. Only those shots weighing 4 kilograms (8 pounds 13 ounces) were used in the evaluation. The actual allowable error was 8 pounds 13 ounces plus or minus 1 ounce. Only those discus weighing 1 kilogram

(2 pounds 3.274 ounces) were used in the thirteen, fourteen and fifteen year old age groups while the 3 pound 9 ounce discus was used by the sixteen, seventeen, and eighteen year olds. In each case the allowable error was plus or minus one ounce.

Each teacher was asked to double check course measurements for the 100 yard and 880 yard events as well as all other measuring devices used in the evaluation procedures.

VI. EVALUATION SCHEDULE

The evaluations at each school were administered by the regular physical education teacher. The physical education teacher was in some instances assisted by students but the actual responsibility of timing or measuring was with the teacher in all cases. Although the hexathlon would probably be administered to several groups simultaneously during a regular physical education class period it was decided to extend the evaluation over a minimum of four periods. The nature of the study made it necessary to conduct the tests according to prescribed standardized instructions.

It was impossible to standardize the amount of preparation or experience of each student prior to evaluation. Teachers were instructed to administer the tests on four successive periods upon completion of the track and field unit of instruction. Most students had participated in track and field activities for a minimum of two weeks

prior to testing.

Schedule of Events

Prior to Day I. Forms were filled out with students' name and age. Facilities were prepared as explained in the instructional booklet.

Day I. The one-half mile run and shot-put events were administered and times or distances recorded.

Day II. The one-hundred yard dash and running long jump events were administered and times or distances recorded.

Day III. The running high jump event was administered and height was recorded.

Day IV. The discus event was administered and distance was recorded. If time permitted a second trial for the one-half mile was administered. The best time of the two trials was recorded.

After Day IV. Testing was completed and recording forms were checked or completed.

VII. ADMINISTRATION OF THE TESTS

General

All data was to be recorded on the prepared score cards and converted for transfer to IBM punch cards.

Age was recorded in years only as of June 1st 1967. A pupil who had his fourteenth birthday on or before June 1st was considered fourteen. A pupil who had his fourteenth birthday after June 1st was considered thirteen for the purposes of the study. The June 1st date is the

date used by the OVSAA in all their track meets. The AAU uses a similar method of determining age.

All measurements were made in regular physical education classes and when the individual wore a complete gymnasium uniform.

Motivation

Teachers were instructed to explain the purpose of the study and answer any question. The boys were asked to give their best performance in each event. Teachers encouraged rivalry between individuals, classes, and other schools. Verbal encouragement could be given during each event. It was expected that students were aware that much of the evaluation used for this study would also be used by the teacher in the grading for this year. Although it was recognized that motivation was difficult or impossible to standardize the instructions above would most closely approximate the condition of performance of the hexathlon in another year at another school in a regular physical education class period.

Warm-Up

A warm-up was considered necessary for best results, especially in a high energy type of activity (42). Warm-up was considered most useful when it was specific to the activity planned (4). No attempt was made to regularize warm-ups as to intensity. Even if there was an attempt to standardize intensity, individual differences would still

not allow the standardization desirable. Teachers were requested to conduct a five minute warm-up appropriate to the particular event being tested. Students not actually being evaluated could warm-up on their own for the next event.

VIII. ADMINISTRATION OF THE EVENTS

100 Yard Dash

The dash was to be run over a lined one hundred yard course on a grass surface. All races were run in pairs with one watch used by the teacher to time each runner. All times were recorded to one-tenth of a second. When time permitted, each runner was allowed two trials and the better one taken as this score. The starters' commands were "On your marks", "Set", "Go". The starter brought his raised arm down sharply at the same instant shouted Go. Time was started when the hand reached the belt line. The starter was to whistle back false starts. Whenever wind was a factor, students ran in a cross-wind direction.

880 Yard Run

Each student completed a half mile run on a rectangular grass course. Times were recorded to the nearest second. Students were divided into two groups for running and timing the half-mile. One group were timers the other runners, the groups alternated.

One watch was used by the teacher for all timing. The timers were instructed to listen for their partners

time as he crossed the finish line. The same starting commands were used as in the 100 Yards. Lap times were given as the runners passed the starting point. During the final lap the student timers were instructed to remain silent and listen carefully to the timer. The teacher stood on the finish line and called out the seconds as they elapsed. The last time called before the runner crossed the finish line was recorded on the score card in minutes and seconds and later converted to seconds. If a second trial was allowed the best time was recorded.

Running High Jump

Regular high jumping rules were followed. Three consecutive failures, regardless of the height at which they occurred, terminated each boy's performance. His best jump was recorded to the nearest inch. The height of the bar was recorded for each time the bar was raised. Measurements were made perpendicular from the ground to the top of the bar. Jumping was to start at 30 inches for all age groups, and increased by an inch interval to 36 inches, then two inches at a time. No passes were allowed.

Running Long Jump (Modified)

A jumping area of 30 inches was required extending from 6 inches in front of the take off board. Care was taken that the take off area was hard packed dirt and was lightly sprinkled with sand. Jumps were measured from the actual take off, spot to the point of landing providing

take off comes within the 30 inch area. A student was allowed three measurable jumps with the longest jump recorded to the nearest inch. Foul jumps were not measured. If a person fell backward upon landing no measurement was taken and an additional trial was given.

Shot-Put (4 Kilogram)

A 4 Kilogram shot was put from a grass circle having a diameter of seven feet. A toe board was not used as some schools did not have this equipment. Each boy was given three measurable throws and the best recorded to the nearest inch. The teacher was instructed to check carefully to insure that the shot was "put" from the shoulder and not thrown. The rule states:

> The shot shall be put from the shoulder with one hand only. At the time the competitor takes a stance in the ring to commence a put the shot shall touch or be in close proximity to the chin and the hand shall not be dropped below this position during the action of putting. The shot must not be brought behind the line of the shoulders. (25)

The best distance of three throws was measured on a straight line from the center of the circle to the point of impact of the shot on the ground. Measurement was recorded from the point of landing to the front edge of the circle.

Throwing the Discus

The discus was thrown from a grass circle having a diameter of 8 feet $2\frac{1}{2}$ inches. The thirteen, fourteen, and fifteen year old boys threw a 1 kilogram discus (2 pounds

3.274 ounces) while the sixteen, seventeen and eighteen year old boys threw the intermediate discus (3 pounds 9 ounces). A discus ring was not used as some schools did not have this piece of equipment. Each boy was given three measurable throws and the best recorded to the nearest inch. Foul throws were not measured. The throw was measured through the center of the circle in a straight line with the point of impact with the ground, from the front edge of the circle.

IX. TREATMENT OF THE DATA

Completed data forms were received from all sixteen schools included in the sample. Performance scores were then converted to seconds for the running events and to inches for the jumping and throwing events using conversion tables.

All information was transferred to IBM punch cards in order to facilitate the sorting, tabulating, and calculating of results. Cards were sorted into six age groups then put into the IBM 360 computer at the University of Alberta using a modification of the program DT100. The information in output included sample size, range, minimum and maximum, mean, and standard deviations for each age group and for each event. In addition each score was transformed to a T-score having a mean of 50 and a standard deviation of 10. Normalization of the T-score distribution was also included in the computer output.

Calculation of T-Scores

All calculations for both T-scores and percentiles were done using the 360 computer. The formula used to calculate T-scores involved a linear transformation such that the mean was adjusted to 50 and standard deviation to 10. For example, a T-score of 65 would involve the transformation while a T-score of 30 would be the result of the mean score minus twice the standard deviation.

Times in the 100 yards were rounded off to the nearest tenth of a second and times in the half mile were rounded to the nearest full second, then converted to minutes and seconds.

Distances for all other events were rounded off to the nearest inch and then converted to feet and inches.

Calculations of Percentiles

Percentile tables were calculated using a normal transformation technique described by Ferguson (15). (See Appendix C, page 110, for formula.) Every percentile rank corresponds to a point on the baseline of the unit normal curve measured from a mean of zero in standard deviation units. A percentile rank of 50 corresponds to the zero point as well as the mean point of the sample distribution. A rank of 80 is 0.84 standard deviation units above the mean. A rank of 40 is -0.25 standard deviation units below the mean. Table 1 shows points on the baseline of the unit normal curve corresponding to selected percentile ranks.

These points and any others are obtained from a table of areas under the normal curve found in many statistical texts (16) (45).

Calculations of percentile ranks were done using the 360 computer. Times and distances were converted using the same method as for T-scores.

TABLE I

POINTS ON THE BASE LINE OF THE UNIT NORMAL CURVE CORRESPONDING TO SELECTED PERCENTILE RANKS

Required Percentile Rank	Standard Deviation or t-score
99	+ 2.33
95	+ 1.65
90	+ 1.28
85	+ 1.04
80	+ .84
75	+ .67
70	+ .52
65	+ .39
60	+ .25
55	+ .13
50	0.00
45	- .13
40	- .25
35	- .39
30	- .52
25	- .67
20	- .84
15	- 1.04
10	- 1.28
5	- 1.65
1	- 2.33

Plotting of Graphs

A graph was plotted for each of the six hexathlon events showing the relationship between the age of the

participant and the mean score. Fleishman (18) used a similar technique and termed these graphs as "developmental curves". One standard deviation above and below each mean was also shown on all graphs. This method was similar to a technique used in the Physical Capacity of Canadian Children (7).

CHAPTER IV

RESULTS AND DISCUSSION

I. INTRODUCTION TO TEST RESULTS

Completed score cards were received from all sixteen schools included in the selected sample. Raw scores of performance were received for 1,183 boys divided into six age groups and for all six events of the Okanagan Hexathlon. Seventeen scores were obtained for twelve year old boys and twenty seven scores received for boys older than eighteen as of June 1. Fifty-six scores were obtained from classes not originally selected in the sample. All results of boys not originally included in the selected sample, or not meeting the age requirements, were discarded.

The primary purpose of this study was to obtain comparative scores in track and field events, particularly in those events that had different units of measurement. Comparisons of achievement could then be made between age groups in the same event or between events in the same age group.

An achievement scale is used to interpret relative levels of accomplishment and therefore must be clearly understood by the person wishing to use it. A detailed discussion of the use of the tables and the relationship between percentiles, T-scores, and the normal curve, will be presented in this chapter.

II. DESCRIPTION OF SAMPLE

Physical education classes were selected at random from the 145 classes available for the study. Altogether 1,183 from sixteen Okanagan schools, participated in establishing normative tables for the Okanagan Hexathlon.

Figure 1, page 47, a map of the geographic area, shows the relative location of the schools included in the sample group. Although chosen at random, the schools selected were considered as representative of the area containing the population under consideration. Two schools were selected from both Vernon and Penticton while each of the other major centers were represented by at least one class. Table II, page 48, gives a better visual picture of the actual number of students chosen in each school and for each age group. For example, 24 senior boys from one class at the Salmon Arm Secondary School were chosen. The actual range of pupil participation varied from a low of 20 boys at the Similkameen Junior Senior Secondary School to a high of 166 boys from the Vernon Senior Secondary School. Table II also shows the sample size for each age group.

Population scores shown in this same table are based on a survey conducted by the physical education Teachers. In some cases this total was an estimation rather than an accurate count. Population figures were based on the sixteen schools available to the study. True statistical inferences may only be made to this population. These sixteen schools made up 72.8 per cent (sixteen out of twenty-

one) of all secondary schools in the Okanagan and contained approximately 68 per cent of the total number of boys actively participating in physical education in all of the schools of the area.

The sample was considered as being an unbiased representative of the population. The computed standard scores (T-scores) were obtained by a linear transformation to a mean of fifty and a standard deviation of ten. Percentile scores were calculated using areas under the normal distribution curve.

III. HEXATHLON TABLES

Interpretation of T-Scores. Care must be taken in the interpretation of the scoring tables as represented in Tables IV, V, VI, VII, VIII, and IX. For example, Table V, page 59, indicated that a T-score of 5 was equivalent to a throw of negative 4 feet 6 inches.

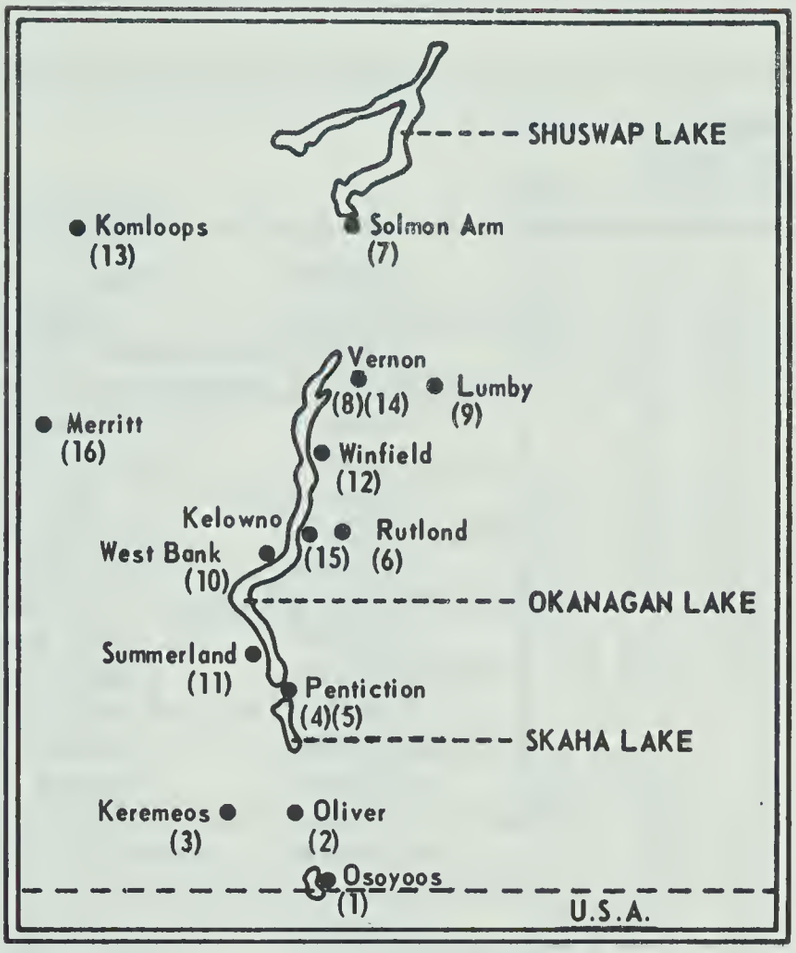


Figure 1. DISTRIBUTION OF SAMPLE - MAP OF OKANAGAN VALLEY OF BRITISH COLUMBIA

KEY: Location of Schools

1. Osoyoos Junior
2. Southern Okonagon
3. Similkomeen
4. Penticton
5. McNicoll Pork Jr.
6. Rutlond
7. Solmon Arm Senior
8. W.L. Seoton Jr.
9. Chorles Bloom
10. George Pringle
11. Summerland
12. George Elliot
13. John Peterson Jr.
14. Clarence Fulton Senior
15. Kelowno
16. Merritt

TABLE II

SAMPLE SIZE COMPARED WITH POPULATION SIZE FROM EACH SCHOOL CLASSIFIED BY AGE OF PUPILS

ID	School		Age in Years as of June 1st 13	14	15	16	17	18	Total
01	Osoyoos Junior Secondary	sample	10	12	8	3	1	2	36
		population	23	21	39	22	5	2	112
02	Southern Okanagan Jr. Sr. Secondary	sample	12	17	35	19	15	5	103
		population	7	44	36	45	64	32	228
03	Similkameen Jr. Sr. Secondary	sample		9	8	3			20
		population	8	14	20	21	17	8	88
04	Penticton Jr. Sr. Secondary	sample	11	21	15	16	32	24	119
		population	20	59	55	46	78	59	317
05	McNicoll Park Junior Secondary	sample	20	49	36	24	3		132
		population	27	71	55	37	10		200
06	Rutland Jr. Sr. Secondary	sample	12	19	17	8	4		60
		population	7	29	36	36	22	2	132
07	Salmon Arm Senior Secondary	sample				1	13	10	24
		population				5	31	31	67
08	W. L. Seaton Junior Secondary	sample	33	12					45
		population	48	50	65	8	2		173
09	Charles Bloom Jr. Sr. Secondary	sample		6	13	12	5		36
		population	7	20	28	15	2		72
10	George Pringle Jr. Sr. Secondary	sample	9	9	9	11	2		40
		population	22	21	29	15	1		88
11	Summerland Jr. Sr. Secondary	sample	10	19	29	7	6	1	72
		population	22	43	45	23	10	4	147
12	George Elliot Jr. Secondary	sample	6	6	15	18	17	11	73
		population	39	65	59	61	23	6	253
13	John Peterson Jr. Secondary	sample	57	57	16	3			134
		population	83	155	104	56	22	3	423
14	Clarence Fulton Secondary	sample		2	29	39	38	39	166
		population		5	44	70	76	70	265
15	Kelowna Jr. Sr. Secondary	sample	19	23	41	22	9	7	121
		population	39	102	122	79	53	39	434
16	Merritt Jr. Sr. Secondary	sample	1	7	3		2	8	21
		population	4	10	12	18	8	10	62
	Total Selected		200	268	274	186	147	108	1183
	Total Available		356	709	749	557	424	266	3061

Note: Population totals are based only on the sixteen schools participating in this study. The population totals were surveyed prior to testing and in some cases were estimations rather than actual tallies.

Table V also showed that a fourteen year old boy would have to put the shot 46 feet 3 inches or set a new world record of 8.4 seconds in the 100 yard sprint to have earned a point value of 95.

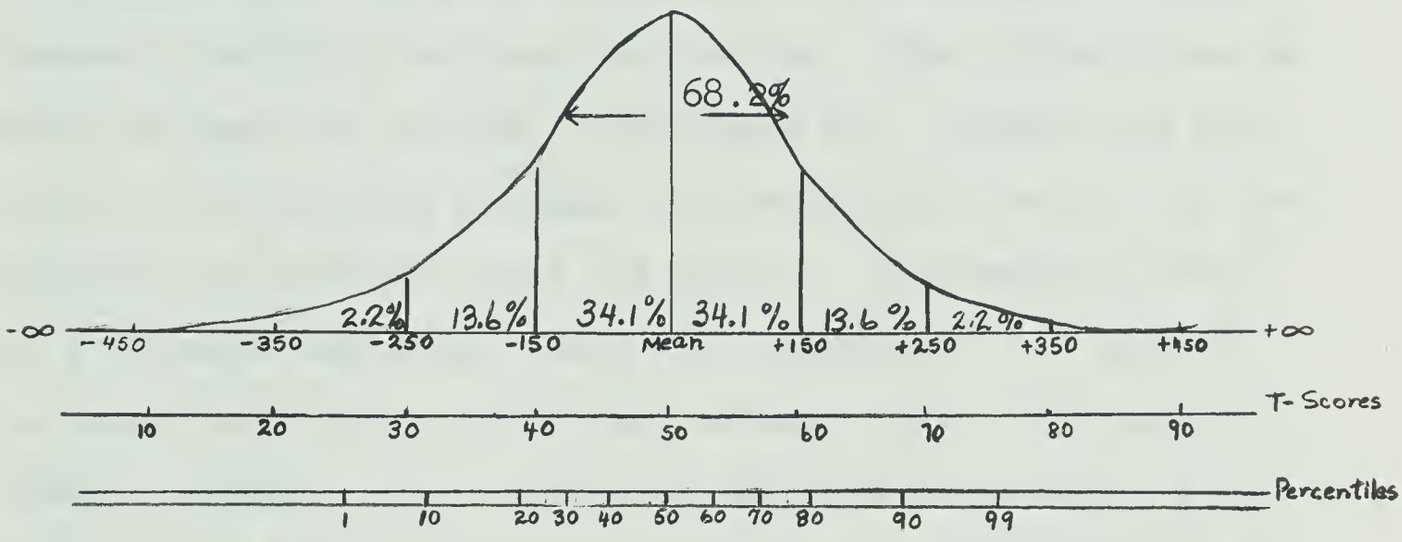
The T-scale was constructed to have five standard deviations above and below the mean. The mean performance was expressed as a score of 50 points and each standard deviation, as calculated from the data, added or subtracted 10 points.

Most people tend to have a better understanding of percentiles. A T-score of 85 is equivalent to a percentile rank of 99.977 (32). Table I, page 42, indicates this is approximately 2.33 standard deviations above the mean. The top end of the normal curve is generally considered to cover three standard deviations above the mean while the T-scale is constructed to include five standard deviations above the mean. Table III, page 50, shows the relationship between percentiles, and T-scores in comparison with the mean and standard deviation units represented on the normal curve. The same table also shows the grouping of the percentile scores about the mean. Looking at the range of one standard deviation from the mean it is noticed that this area should contain 68.2 per cent of the normal population. Here, the range of T-scores is from forty to sixty (by definition) while the range of percentiles is somewhat less than twenty and greater than eighty (15.87 percentile to 80.23 percentile (32)). The full range of T-scores (five standard

deviations) is not shown.

TABLE III

THE NORMAL CURVE AND ITS RELATION
TO T-SCORES AND PERCENTILES



The upper and lower limits are not to be considered as pragmatic levels of achievement. Scott (41) and Ferguson (17) indicate that T-score tables should actually only range from twenty to eighty. The performance scores in this study were found to range from an equivalent T-score of 20.9 to a high of 79.2.

Mathews (35) also reported the ends of a T-scale "impossible" when his results showed a negative number of sit-ups. In the present study, negative distances were also calculated in the discus event for the thirteen, fourteen, fifteen, and sixteen year old age groups equivalent to a T-score of 0. The fourteen year old group also included a

negative distance equal to a T-score of five (see Table V, page 59). The T-score Tables were extended to values ranging from zero to one hundred to show the theoretical limits.

The upper limits of the T-score distributions (above a T-score of eighty) can be useful only if they are interpreted correctly. Actual performance scores will almost invariably fall below the equivalent one hundredth T-score, thereby providing continued motivation. The dotted lines on Table VI page 60, and Table VIII page 62, indicate the position of the existing Okanagan interscholastic record for the fifteen and seventeen year old groups. Performance scores in a physical education class would generally be expected to range below this line at the present time. The upper limits, however, still allow for improved performance some time in the future. They should never be interpreted as a standard, or feasible goal of achievement.

Standard scores were used in order that measurement and evaluation scores, using different units of measurement which vary in size and variability, could be made comparable. Therefore comparisons from one event to another are allowed. A time of 2 minutes 22 seconds was equal to a score of 70 points. (See Table VII, page 61). A sixteen year old must put the shot 40 feet 10 inches or have a long jump distance of 17 feet 5 inches to do as well. T-scores may be compared, added or averaged providing the distributions were similar (2). Comparisons may also be made from one age group to another. Table VI, page 60, shows that a fifteen year old

boy would have to run the 880 yards in 3 minutes 43 seconds to be awarded 35 points while Table IV, page 58, shows that a time of 3 minutes 50 seconds was the equivalent time for a thirteen year old boy.

Reading Hexathlon Tables. The complete results of the testing program are included in Tables IV, V, VI, VII, VIII, and IX, pages 58, 59, 60, 61, 62, and 63, in a standard score form. The mean score was set to have a value of fifty and each standard deviation an increase or decrease of ten points. Classification of participants was by age and separate tables were prepared for each age group. For example Table V, page 59, refers to scores of the fourteen year old boys in each of the six events. When reading the tables the first step is to find the performance score corresponding to the event and classified by age. The fourteen year old boy who ran the 100 yards in 11.4 seconds would find that score on Table V, then follow horizontally to the left hand column to find the point value equivalent to that performance score. In this example, 11.4 seconds was equivalent to a point score of 70.

Where the exact score is not included it could be inserted between the two nearest scores and the T-score value interpolated. This procedure may be reading into the tables more accuracy than actually exists especially if a person then attempts to distinguish between adjacent T-scores. Very often a value equivalent to one-tenth of a

standard deviation, (here one T-score) is the limit of accurate discrimination between scores. In view of the imperfect reliability of performance scores in general, the unit of the T-scale may often be smaller than is justified. Guilford (23) supports this argument and adds:

> T-scores then give an appearance and an assurance of discriminations that cannot actually be made. Remember that in many single tests the standard deviation is less than 10 score points, which means that the T-scale unit of 0.1 standard deviations is then smaller than the original raw score unit. (23)

Points should be awarded only for one T-score value until such time as the performance score reaches the next highest score listed on the table. In Table VIII, page 62, a shot put of 36 feet 9 inches was awarded a comparative score of 55 points. No higher score in that event would be awarded until the boy could put the shot 39 feet 2 inches. He would then receive 60 points. If necessary, more precise comparisons could be made between actual scores rather than converted scores.

Profiles. The Hexathlon of T-score tables (Tables IV-IX) may also be used to plot the performance profile of an individual. The six events of one age group have been included in a single table for greater convenience in comparing scores. The nearest performance score is found on the appropriate table and circled. By encircling his score and drawing lines between them, a student has a profile of his achievement showing strengths and weaknesses in comparisons between events. If possible, each student should be given a mimeographed card showing the printed T-scales

so he can draw his own profile. Scores made at a later date could be marked with a different color if desired. Table IV, page 58, shows how an example profile could be charted. The performance scores for a thirteen year old boy were circled and joined by a straight line. This boy recorded a shot put distance of 20 feet 2 inches and a time of 2 minutes 23 seconds in the 880 yard run. These scores were then circled as shown. Because of the corresponding T-score values this example profile shows strength in both of the running events and the long jump as compared with a relatively weaker performance in the other events.

Description of Results. Hexathlon scoring tables are in the form of T-scores; the results are found in Tables IV, V, VI, VII, VIII, and IX with one table for each age group.

Table X, page 64, gives the sample size for each age group as well as the mean and standard deviation for every event in the separate age groupings. This table also gives the best performance (maximum), and the poorest performance (minimum), for each event and each age group.

Percentile norms are based on the expected frequency of the normal or bell-shaped curve with the mean score set equal to the fiftieth percentile. The percentile results are found in Tables XI, XII, XIII, XIV, XV, and XVI, with one table for each age group.

Developmental curves, showing the relationship between performance or achievement and age are found in

Figures 2, 3, and 4. Figure 2, page 69, graphs the running events; Figure 3, page 70, the throwing events; while Figure 4, page 71, is the graph of the two jumping events.

The following paragraphs contain general descriptions of each of the tables. It is expected that more particular information will be required and the actual tables consulted.

Thirteen Year Old Age Group. There were 200 boys included in the thirteen year old section of the study. The mean long jump performance was 12 feet 2 inches and the mean discus throw distance was 58 feet 8 inches. Mean and standard deviations were calculated for each event. As in all of the following tables, the T-score values less than 20 or greater than 80 often indicated unrealistic levels of achievement. Of the 200 boys who ran 100 yards the best time was 12.0 seconds or an equivalent T-score of 65. Correspondingly the slowest time was 19.9 seconds corresponding to a T-score value of 10. Table XI, page 78, shows the percentile scores for this age group. The normalized percentile tables showed a range from 2 minutes 15 seconds to 4 minutes 10 seconds in the 880 yard race.

The maximum and minimum scores in the same age group were found to be 2 minutes and 25 seconds to a slow 5 minutes and 27 seconds. In this case the percentile tables or the T-score tables were not adequate to cover all scores found in the sample.

Fourteen Year Old Age Group. The mean score

improved for every event when comparing this group with the younger boys. There were 268 boys in the fourteen year old group in this study. The mean performance in the discus throw was 66 feet 7 inches with an actual range of raw scores 20 feet 2 inches up to a good throw of 120 feet. The 70th percentile point corresponds to a throw of 74 feet 9 inches. The lower limits of the discus event in Table V, page 59, were not meaningful in measures of achievement. A boy needed only to drop the discus 3 feet 5 inches in front of the circle for 10 points while the scores from 5 down indicated a negative value.

Fifteen Year Old Age Group. Tables V, page 59, and IX, page 63, show the basic results of this age grouping. The largest sample size, 274 boys, from 14 schools participated in this part of the study. The mean high jump distance was 4 feet 2 inches with a standard deviation of only 5 inches. The relatively small standard deviation was characteristic of the high jump and sprint events for all age groups. The actual range of jumps (Table X, page 64) was from 3 feet to a good jump of 5 feet 4 inches. In all high jump events the starting height was 2 feet 6 inches; followed by the next jump at 3 feet. Some accuracy was lost by this procedure and therefore the interpretation given to low jumps must be carefully formulated.

Sixteen Year Old Age Group. There were 186 boys in the sixteen year old section of this study. The outstanding performance by sixteen year olds was a long jump

of 19 feet 2 inches. The mean long jump distance was 14 feet 5 inches with a standard deviation of 18 inches. Table VII, page 61, shows that the outstanding jump was awarded a T-score of 80. The corresponding shortest jump was 9 feet 4 inches or 25 points. The minimum and maximum jumps were beyond the percentile scale as shown in Table XIV, page 81.

Seventeen Year Old Age Group. The maximum scores in the shot-put, high jump, and discus events in this age group were also the corresponding maximum values of all 1183 boys included in the study. The sample for this age group was composed of 147 boys from 13 different schools. The mean shot put distance was 34 feet 4 inches with a standard deviation of 57 inches. A shot put distance of 36 feet 10 inches was equivalent to a percentile score of 70 and a T-score of 55.

Eighteen Year Old Age Group. There were 108 boys in the sample of eighteen year olds. This was the least number or smallest sample of the six sample groups in the study. The mean time in the 100 yards was 12.4 seconds and a standard deviation of 0.74 seconds. The best score was a time of 10.5 seconds while the slowest boy took 15.1 seconds to run the one hundred yard distance.

IV. RANGE, MINIMUM AND MAXIMUM SCORES

A summary of the means and standard deviation for each age group and for each event is contained in Table X, page 64. This table also contains the sample size for each age classification. The ranges of scores for each separate

TABLE IV

HEXATHLON SCORES OF OKANAGAN HIGH SCHOOL BOYS FOR SELECTED TRACK AND FIELD EVENTS THIRTEEN YEAR OLD BOYS

T-Score Units	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
100	1:09	41-10	7.7	19-10	5-8	121-6
95	1:21	39-10	8.4	19-1	5-6	115-3
90	1:34	37-10	9.0	18-3	5-4	108-11
85	1:46	35-10	9.7	17-6	5-1	102-8
80	1:58	33-11	10.4	16-9	4-11	96-4
75	2:11	31-11	11.1	16-0	4-8	90-1
70	2:23	30-0	11.8	15-3	4-6	83-10
65	2:36	28-0	12.4	14-6	4-4	77-6
60	2:48	26-0	13.1	13-9	4-1	71-3
55	3:00	24-1	13.8	12-11	3-11	65-0
50	3:13	22-1	14.5	12-2	3-8	58-8
45	3:25	20-2	15.2	11-5	3-6	52-5
40	3:37	18-2	15.8	10-8	3-4	46-1
35	3:50	16-3	16.5	9-11	3-1	39-10
30	4:02	14-3	17.2	9-2	2-11	33-7
25	4:15	12-4	17.9	8-5	2-8	27-3
20	4:27	10-4	18.5	7-7	2-6	21-0
15	4:39	8-5	19.2	6-10	2-4	14-9
10	4:50	6-5	19.9	6-1	2-11	8-5
5	5:04	4-6	20.1	5-4	1-11	2-2
0	5:17	2-6	21.3	4-7	1-9	- 4-1
Mean:	3:13	22-1	14.5	12-2	3-8	58.8
S.D.:	25	47	1.4	18	4.8	151

Number in sample = 200

Note: Circled scores indicate a sample profile.

TABLE V

HEXATHLON SCORES OF OKANAGAN HIGH SCHOOL BOYS FOR SELECTED TRACK AND FIELD EVENTS FOURTEEN YEAR OLD BOYS

T-Score Units	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
100	1:01	48-6	7.8	21-8	5-11	145-6
95	1:13	46-3	8.4	20-9	5-9	137-7
90	1:25	43-11	9.0	19-11	5-6	129-8
85	1:38	41-8	9.6	19-0	5-4	122-10
80	1:50	39-4	10.2	18-2	5-2	113-11
75	2:02	37-0	10.8	17-2	4-11	106
70	2:15	34-8	11.4	16-5	4-9	98
65	2:27	32-5	12.0	15-7	4-6	90-2
60	2:39	30-1	12.7	14-8	4-4	82-4
55	2:52	27-8	13.3	13-10	4-1	74-5
50	3:04	25-5	13.9	12-11	3-11	66-7
45	3:17	23-2	14.5	12-1	3-9	58-8
40	3:29	20-1	15.1	11-3	3-6	50-9
35	3:41	18-6	15.7	10-4	3-4	42-10
30	3:53	16-3	16.3	9-6	3-1	35-0
25	4:05	14-2	16.9	8-7	2-11	27-1
20	4:18	11-7	17.5	7-9	2-8	19-2
15	4:30	9-3	18.1	6-10	2-6	11-3
10	4:42	7-0	18.7	6-0	2-3	3-5
5	4:45	4-8	19.3	5-1	2-1	- 4-6
0	5:08	2-4	19.9	4-3	1-11	-12-5
Mean:	3:04	25-6	13.9	12-11	3-11	66-7
S.D.:	25	55	1.2	21	4.9	190
Number in sample = 268						

TABLE VII

HEXATHLON SCORES OF OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
SIXTEEN YEAR OLD BOYS

T-Score Units	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
100	1:36	56-11	8.5	21-11	6-4	146-2
95	1:43	54-5	9.0	21-2	6-2	138-2
90	1:51	51-11	9.4	20-5	5-11	131-6
85	1:59	49-5	10.0	19-8	5-10	124-2
80	2:07	46-11	10.3	18-11	5-6	116-11
75	2:14	44-4	10.7	18-2	5-4	109-7
70	2:22	40-10	11.2	17-5	5-2	102-4
65	2:30	39-4	11.6	16-8	4-11	95-0
60	2:37	36-10	12.1	15-11	4-9	87-8
55	2:45	34-4	12.5	15-2	4-6	80-4
50	2.53	31-10	12.9	14-5	4-4	73-1
45	3:01	29-4	13.4	13-8	4-1	65-9
40	3:08	26-10	13.8	12-10	3-11	58-5
35	3:16	24-4	14.3	12-1	3-8	51-2
30	3:24	21-10	14.7	11-4	3-6	43-10
25	3:31	19-4	15.1	10-7	3-3	36-6
20	3:39	16-10	15.6	9-10	3-1	29-3
15	3:47	14-4	16.0	9-1	2-10	21-11
10	3:54	11-10	16.5	8-4	2-8	14-7
5	4:02	9-4	16.9	7-7	2-6	7-3
0	4:10	6-10	17.3	6-10	2-3	- 5-0
Mean:	2:53	31-10	12.9	14-5	4-4	73-1
S.D.:	15	60	0.9	18	4.9	175
Number in sample = 186						

TABLE VI

HEXATHLON SCORES OF OKANAGAN HIGH SCHOOL BOYS FOR SELECTED TRACK AND FIELD EVENTS FIFTEEN YEAR OLD BOYS

T-Score Units	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
100	:50	52-7	6.8	22-2	6-3	159-0
95	1:03	50-2	7.5	21-4*	6-1	150-6
90	1:16	47-9*	8.1	20-6	5-10	142-2
85	1:29	45-5	8.8	19-7	5-7	133-10
80	1:42	43-0	9.5	18-9	5-5*	125-5
75	1:55	40-7	10.1	17-11	5-2	117-1
70	2:08*	38-2	10.8*	17-1	5-0	108-9 *
65	2:21	35-10	11.4	16-3	4-9	100.5
60	2:34	33-5	12.1	15-5	4-7	92-0
55	2:48	31-0	12.7	14-6	4-4	83-8
50	3:01	28-8	13.4	13-8	4-2	75-4
45	3:14	26-3	14.0	12-10	3-11	67-0
40	3:27	23-10	14.7	12-0	3-9	58-7
35	3:40	21-6	15.3	11-2	3-6	50-3
30	3:53	19-1	16.0	10-5	3-3	41-11
25	4:06	16-8	16.7	9-6	3-1	33-7
20	4:19	14-4	17.3	8-7	2-10	25-2
15	4:32	11-11	18.0	7-9	2-8	16-10
10	4:45	9-6	18.6	6-11	2-5	8-5
5	4:58	7-2	19.3	6-1	2-3	1-3
0	5:12	4-9	19.9	5-3	2-0	- 8-3
Mean:	3:01	28-8	13.4	13-8	4-2	75.4
S.D.:	26	57	1.3	20	5.1	200
Number in sample = 274						

* Indicates performance record for 15 year old boys in interschool competition in the Okanagan

TABLE VIII

HEXATHLON SCORES OF OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
SEVENTEEN YEAR OLD BOYS

T-Scores Units	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
100	1:18	58-3	7.7	23-1	6-8	151-1
95	1:27	55-11	8.1	22-3	6-5	143-7*
90	1:37	53-6	8.6	21-5*	6-3	136-1
85	1:46	51-1	9.1	20-7	6-0	128-7
80	1:56*	48-9	9.6	19-9	5-9	121-1
75	2:05	46-4*	10.1*	18-11	5-6	113-7
70	2:15	43-11	10.6	18-0	5-4	106-1
65	2:25	41-6	11.0	17-2	5-1	98-7
60	2:34	39-2	11.5	16-4	4-10	91-1
55	2:44	36-9	12.0	15-6	4-7	83-7
50	2:53	34-4	12.5	14-8	4-4	76-2
45	3:03	32-0	13.0	13-10	4-2	68-7
40	3:12	29-7	13.5	13-0	3-11	61-1
35	3:22	27-2	14.0	12-2	3-8	53-7
30	3:31	24-9	14.4	11-4	3-5	46-1
25	3:41	22-5	14.9	10-6	3-2	38-7
20	3:51	20-0	15.4	9-8	3-2	31-1
15	4:00	17-7	15.9	8-10	2-9	23-7
10	4:10	15-3	16.4	8-0	2-6	16-1
5	4:19	12-10	17.0	7-2	2-3	8-8
0	4:29	10-5	17.3	6-4	2-1	1-1
Mean:	2:53	34-4	12.5	14-8	4-4	76-1
S.D.:	19	57	1.0	20	4.6	180
Number in sample = 147						

* Indicates position of existing performance record for 17 year old boys in interschool competition in the Okanagan.

TABLE IX

HEXATHLON SCORES OF OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
EIGHTEEN YEAR OLD BOYS

T-Score Units	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
100	1:29	55-10	8.7	21-8	6-3	152-3
95	1:38	53-8	9.1	21-0	6-1	144-8
90	1:47	51-7	9.4	20-3	5-11	137-2
85	1:55	49-5	9.8	19-7	5-8	129-7
80	2:04	47-4	10.2	18-11	5-6	122-0
75	2:13	45-2	10.5	18-3	5-4	114-5
70	2:21	43-0	10.9	17-7	5-1	106-11
65	2:30	40-11	11.3	16-10	4-11	99-4
60	2:38	38-9	11.7	16-2	4-9	91-10
55	2:47	36-8	12.0	15-6	4-6	84-3
50	2:56	34-6	12.4	14-10	4-4	76-9
45	3:04	32-4	12.8	14-1	4-2	69-2
40	3:13	30-3	13.1	13-5	3-11	61-7
35	3:22	28-1	13.5	12-9	3-9	54-1
30	3:30	26-0	13.9	12-1	3-7	46-6
25	3:39	23-10	14.2	11-5	3-4	38-11
20	3:47	21-8	14.6	10-8	3-2	31-5
15	3:56	19-7	15.0	10-0	3-0	23-10
10	4:05	17-5	15.3	9-4	2-9	16-3
5	4:13	15-4	15.7	8-8	2-6	8-9
0	4:22	13-2	16.1	7-11	2-5	1-2
Mean:	2:56	34-6	12.4	14-10	4-4	76-9
S.D.:	17	51	0.7	16	4.6	181
Number in sample = 108						

TABLE X

MEAN, STANDARD DEVIATION AND RANGE OF SCORES
FOR EACH EVENT AND EACH AGE CLASSIFICATION

	880 Yards	Shot -Put	100 Yards	Long Jump	High Jump	Discus Throw
AGE 13 Number in Sample = 200						
Minimum	2:25	11-3	12.0	8-0	3-0	28-3
Maximum	5:27	34-9	19.9	16-0	5-2	97-4
Mean	3:13	22-1	14.5	12-2	3-8	58-8
Standard Deviation	25	47	1.4	18	4.8	151
AGE 14 Number in Sample = 268						
Minimum	2:17	15-1	11.2	8-0	3-0	20-2
Maximum	5:56	40-6	18.9	18-5	5-2	120-0
Mean	3:04	25-6	13.9	12-11	3-11	66-7
Standard Deviation	25	55	1.2	21	4.9	190
AGE 15 Number in Sample = 274						
Minimum	2:12	15-6	11.0	7-3	3-0	34-6
Maximum	5:30	43-0	24.0	17-11	5-4	120-0
Mean	3:01	28-8	13.4	13-8	4-2	75-4
Standard Deviation	26	57	1.3	20	5.1	200
AGE 16 Number in Sample = 186						
Minimum	2:16	18-2	11.0	9-4	3-0	* 40-2
Maximum	3:49	47-3	17.5	19-2	5-2	*122-0
Mean	2:53	31-10	12.9	14-5	4-4	* 73-1
Standard Deviation	15	60	0.9	18	4.9	175
AGE 17 Number in Sample = 147						
Minimum	2:21	17-5	10.7	8-3	3-0	* 39-0
Maximum	4:36	52-0	16.6	18-8	5-6	*131-0
Mean	2:53	34-4	12.5	14-8	4-4	* 76-1
Standard Deviation	19	57	1.0	20	5.6	180

TABLE X CONTINUED

	880 Yards	Shot -Put	100 Yards	Long Jump	High Jump	Discus Throw
AGE 18 Number in Sample = 108						
Minimum	2:25	23-5	10.5	9-9	3-0	* 41-4
Maximum	4:17	43-9	15.1	19-0	5-2	*127-0
Mean	2:56	34-6	12.4	14-10	4-4	* 76-9
Standard Deviation	17	51	0.7	16	4.6	181

* Note: Heavier discus

** Standard deviation units are in seconds or inches whichever is appropriate to the event.

Units of Measure: (1) Minimum, Maximum and Mean scores of running events given in minutes and seconds.

(2) Minimum, Maximum and Mean scores in all others given in feet and inches.

(3) Standard Deviation of running events in seconds.

(4) Standard Deviation of all others in inches.

event are included. These maximum and minimum scores represent the actual best and poorest scores recorded during the test period. For example, Table X, page 64, shows that there were 268 boys in the fourteen age group. The best shot put was one of 40 feet 6 inches while the poorest was a put of 15 feet 1 inch. The mean distance was 25 feet 6 inches with a standard deviation of 55 inches. One interesting point was the relationship between time and age in the 100 yard event. The best time (maximum score) was recorded for an eighteen year old boy. The seventeen year olds' maximum was the next best, followed in order by the sixteen, fifteen, fourteen, and thirteen year group's maximum scores. Similarly the mean times were slower with each decrease in age grouping. Contrasted with this was the best performance score in the 880 yards of 2 minutes 12 seconds by a fifteen year old boy while the fastest mean scores were by the sixteen and seventeen year old groups.

A seventeen year old boy had the best high jump performance at 5 feet 6 inches. This same boy also held the district record in the high jump event.

Developmental Curves. Figures 2, 3, and 4, probably give a better visual representation to the relationship between age and performance. These graphs were classified according to events rather than age. Figure 2, page 69, graphs the running events while Figure 3, page 70, gives similar data for the two jumping events. Figure 4, page 71, graphs the throwing events. In all graphs the

six age groups were plotted on the horizontal axis and the mean performance scores were plotted on the vertical axis. Standard deviations were also shown for each mean score.

The graphs involving age and achievement were termed "developmental curves" by Fleishman (18). Comparisons were between mean performances at one testing period. A thirteen year old boy is not necessarily expected to follow this line of development. For example, the fourteen year olds' results were not obtained from the same group of boys who provided the thirteen year olds' results one year ago. Fleishman (18) reported:

> . . . an almost linear increase in performance up to some critical age, beyond which only small additional increases occur.

Fairbanks (16) has shown similar results for all events except the shot put. The results of the present study proved to substantiate these findings.

Running Events. Figure 2, page 69, shows a nearly perfect linear (straight line) relationship existed between age and performance in the 100 yard sprint event. In this graph there was no sharp levelling of performance as described by Fleishman (18). The mean times started at 14.5 seconds for the thirteen year group and followed a straight line to a mean of 12.9 seconds for the seventeen year old group. Standard deviation units were relatively uniform and comparatively smaller than most other events. The thirteen year olds' had the largest standard deviation at 1.4 seconds and the eighteen year old group the smallest at 0.7 seconds.

Throwing Events. Figure 3, page 70, shows that exactly the same linear relationship existed in the shot

put event. There was a linear relationship in mean scores up to age seventeen and then a levelling off. The mean score for seventeen year olds was 34 feet 4 inches while the mean score of the eighteen year old group was only two inches better at 34 feet 6 inches.

The graph of the discus throw is different from the others because of the two different discus weights used in this study. The graph curve of the lighter discus as thrown by the younger ages, showed a sharp linear increase with age from a mean of 58 feet 8 inches by the thirteen year old group to a mean throw of 75 feet 4 inches by the fifteen year olds.

The sixteen, seventeen, and eighteen year old classifications threw a discus that was one pound six ounces heavier; (three pounds nine ounces compared with approximately two pounds three ounces). It was expected that the linear relationship would remain, at least to age seventeen, if the smaller discus had been used throughout the study. Although not comparable, the mean throw of a seventeen year old boy was still greater at 76 feet 1 inch despite the use of a heavier discus.

Jumping Events. The long jump and high jump curves were once again characteristically linear to some age followed by a plateau effect. The developmental curve of the long jump reached a plateau at age sixteen followed by only small increases in the next two groups. Figure 4, page 71, shows that in the long jump the standard deviations

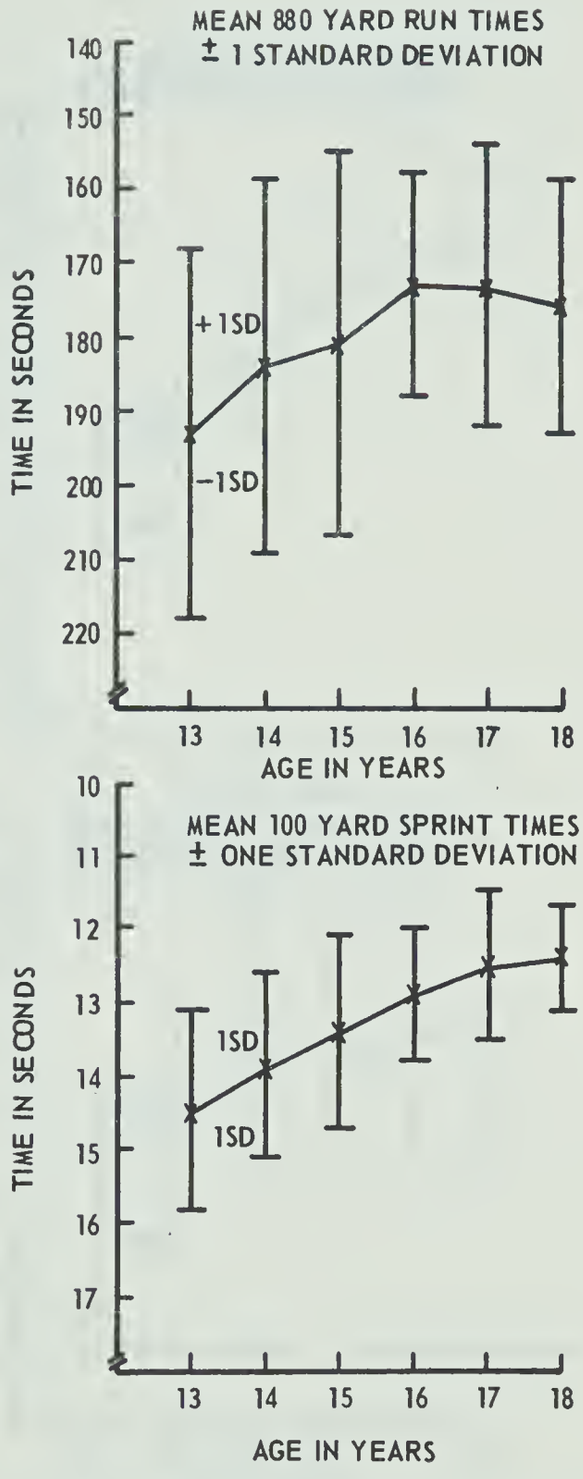
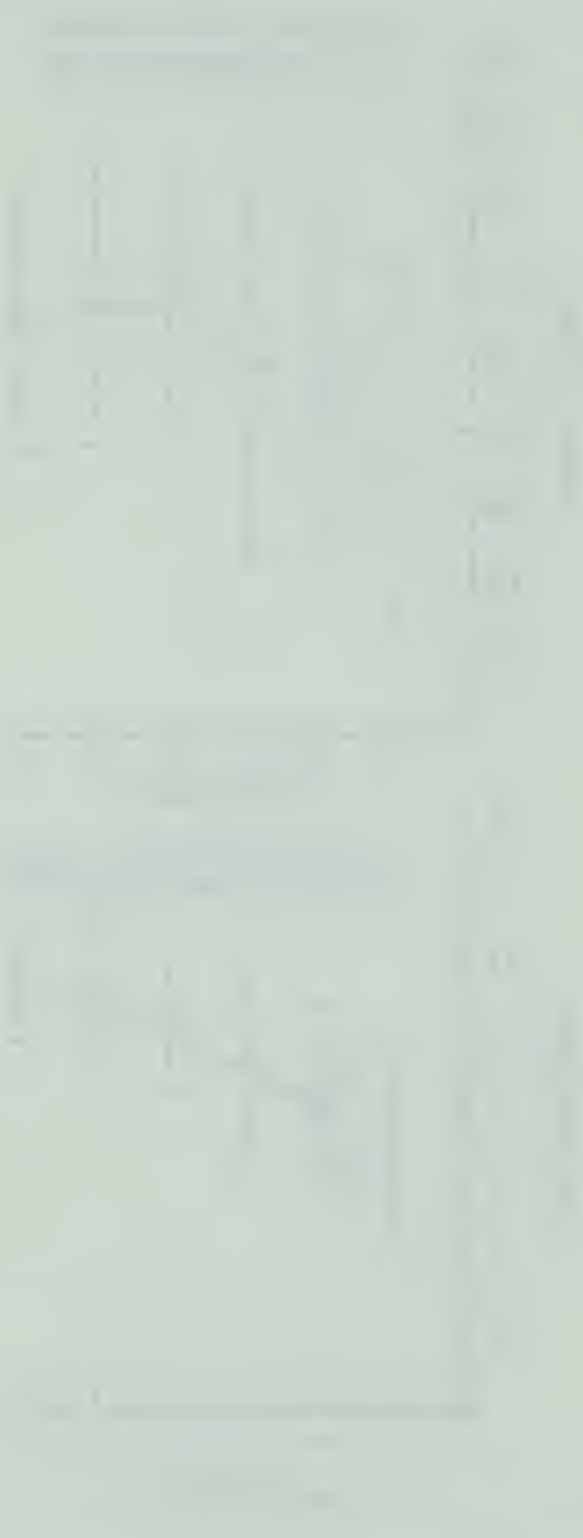


Figure 2. MEAN TIMES PLUS AND MINUS ONE STANDARD DEVIATION FOR THE TWO RUNNING EVENTS OF THE OKANAGAN HEXATHLON.



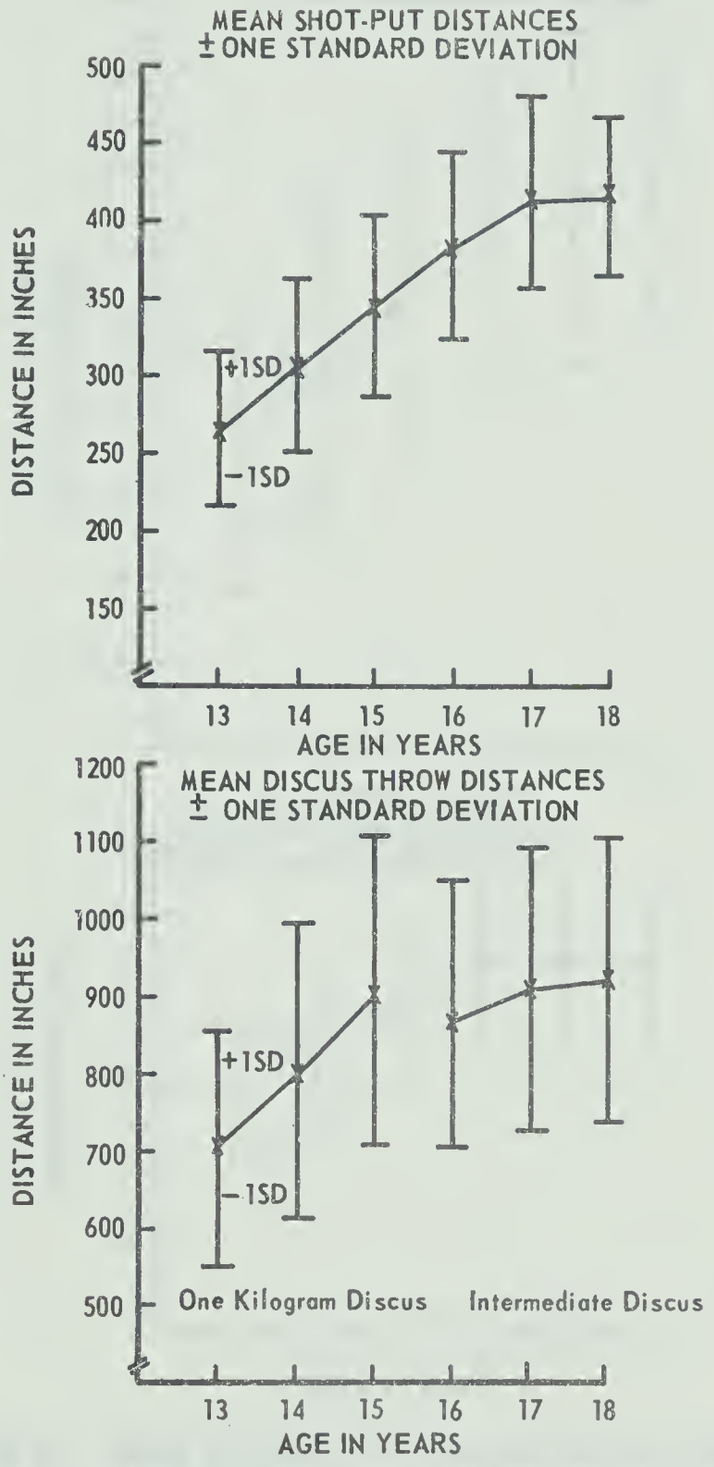


Figure 3. MEAN DISTANCES PLUS AND MINUS ONE STANDARD DEVIATION FOR THE TWO THROWING EVENTS OF THE OKANAGAN HEXATHLON.

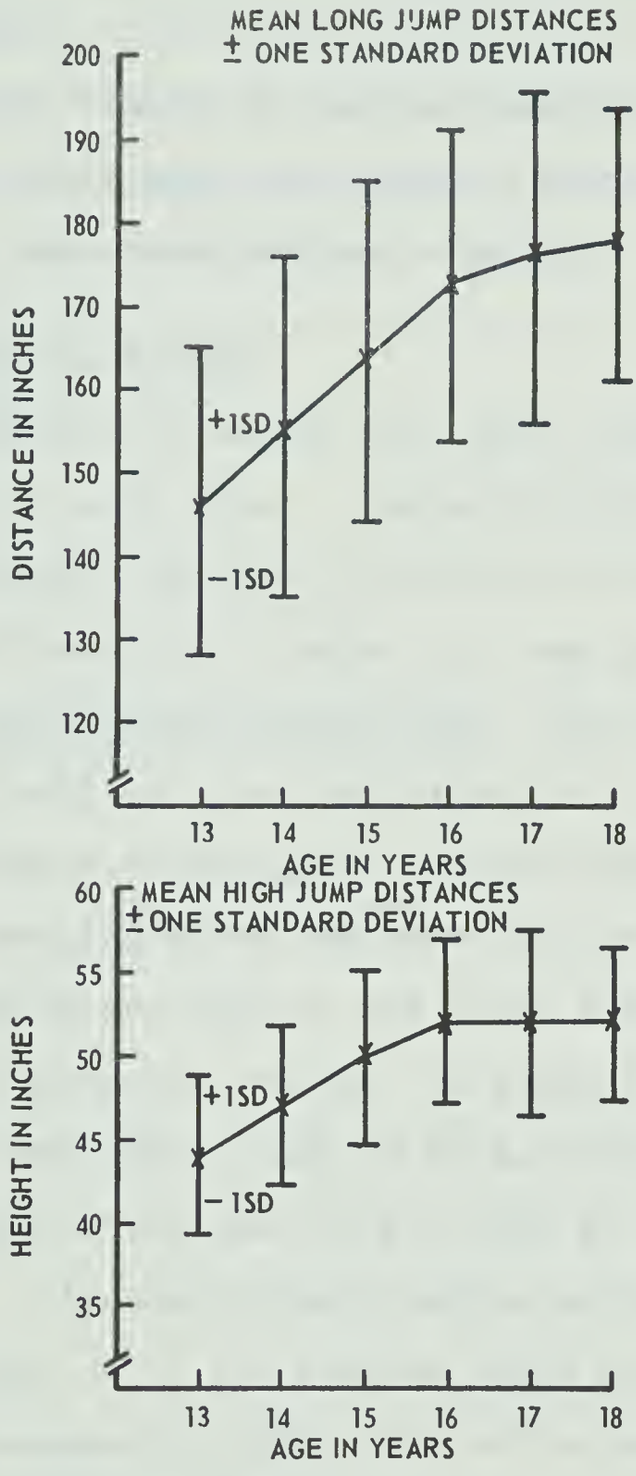


Figure 4. MEAN DISTANCES PLUS AND MINUS ONE STANDARD DEVIATION FOR THE TWO JUMPING EVENTS OF THE OKANAGAN HEXATHLON.

were very uniform for each age group. The actual range of standard deviations was five inches (16 inches to 21 inches, see Table X).

The results of the high jump showed an increase in performance with age up to sixteen years, then equal mean scores for ages seventeen and eighteen.

VI. PERCENTILE TABLES

Percentile tables were also provided for each age group and for each event. Tables XI-XVI, pages 78, 79, 80, 81, 82, 83, provide equivalent percentile and performance scores with classification of tables into age groups.

Interpreting Percentiles. The percentile scale shows the position of an individual in a group on the basis of that portion of the group that he exceeds. It becomes much more meaningful to say that John can run the 100 yards faster than 85 per cent of the other boys his age than it is to say that John can run the 100 yards in 13.1 seconds.

A percentile rank of 85 indicates that his performance was better than 85 per cent of his age group in that event. Another interpretation is that approximately fifteen boys out of one hundred would probably do better while approximately eighty five out of one hundred would either equal that score or do worse.

Percentiles are widely used and provide a method of readily and meaningfully interpreting individual scores relative to the group. Percentile scales are comparatively easy to construct. Consequently, the percentile table is

practical for use in education, especially in the construction and application of percentile norms. However it is most important that one recognizes the basic limitations of these tables. Usually each percentile represents a point, below which a certain percentage of individuals scored, regardless of the dispersion of scores. Consequently, a percentile table does not possess scale units of equal length. The percentile scale makes the assumption that the difference in distance, on a linear scale, between 10 per cent and 20 per cent is the same as the distance between 50 per cent and 60 per cent.

> This assumption is difficult to defend and, consequently, while the scale is very practical it is unsound in theory and hence should not be used (37).

Garrett (19) showed that comparison or averaging of percentiles is sound only between the 75th and 25th percentile points. Other authors do not even allow this much freedom:

> . . . neither the mean nor the variability of the distribution are taken into consideration, as in the case with standard scores. Therefore, data expressed in percentiles cannot be averaged or combined. As a further limitation, percentile values in one group are not directly comparable with those in another. Application of percentile tables should be made in light of these limitations.(36)

Many other authors disagree when they say that percentiles are comparable.

> Percentile scores for entirely different tests are comparable if derived from the same group or sample. the original raw scores might be different units . . . . (33)

Fairbanks (16) studied the shapes of the distributions of the raw scores and found them to vary considerably. He

therefore concluded:

> . . . that standard scores would not give an accurate comparison between performances of an individual on the five test items.

He later adds:

> A percentile rank of 75 has the same meaning in any number of situations regardless of the nature of the distribution. (16)

Table I, page 42, has shown the basic relationship between percentiles and standard deviation units. A comparison between percentiles and T-scores as in Table III, page 50, shows advantages of each. As has been stated before, a T-score distribution covers a range of plus or minus five standard deviation units and therefore the extreme ends of the distributions often become unreal. A percentile distribution covers slightly less than three standard deviations and therefore the top and bottom scores appear as possible levels of achievement.

The percentile tables that were calculated for this study do take into consideration the mean and standard deviation units as well as the expected frequency under the normal curve. Percentiles were included to show the relative position of a performance in relation to the expected normal frequency.

Reading Percentile Tables. Tables XI, XII, XIII, XIV, XV, and XVI, pages 78, 79, 80, 81, 82, and 83, contain percentile equivalents for performance in all events of the Hexathlon. Each table contains one age group. In all tables, the left hand column presents the percentiles;

columns to the right are the scores by event. To evaluate an individual's score, one need only turn to the table for the correct age group, find the participant's score in the appropriate event column, and then read across to the percentile column. The percentile score tells the proportion of a normally distributed population, in a comparable age group, that the individual has equalled or exceeded a particular score on that test. Thus, if a fourteen year old boy was able to run the 100 yards in 15.1 seconds, he scored as high or higher than only 15 per cent of his age group, but if he could do the same distance in 11.9 seconds he would be as good as or better than, 95 per cent. In the latter instance his score was exceeded by only 5 per cent of the normative group. As a rough guide, the 35 and 65 percentiles may be used as cutting points for determining whether or not an individual's score was above or below average, when compared with other boys of the same age. (18)

The user may want to interpolate between the percentiles given to get more precise percentile scores. Thus, the score for a thirteen year old boy who throws the discus 68 feet may be more exactly interpreted as being at the 77 percentile than at either the 75 or 80 percentiles. As in the standard score form, care should be taken to avoid attempting to distinguish between scores that should be considered equal.

The reader will also note that the tables contain some blanks or therefore, the same raw score appears to be

equivalent to more than one percentile score. The rule to follow in such instances is to read the highest percentile equivalent to that raw score. For example, sixteen year old boys who can high jump 4 feet 6 inches are at the 70 percentile, not the 65. The boy who jumps one inch less at 4 feet 5 inches, drops all the way down to the 60 percentile. The results of the high jump event in all age groups showed the duplicate percentiles due to the comparatively small range of scores. Similarly a decrease of one tenth of a second usually results in an increase of five percentile points in the 100 yard dash. Conversely times in the 880 yards or distances in the discus throw are spread over a greater range.

A closer examination of Table XIII, page 80, shows some of the advantages of the percentile tables. The range of scores appeared plausible in all events. For example, the 99 percentile in; the 880 yards was 2 minutes, the shot put was 39 feet 9 inches, and one hundred yards was 10.3 seconds. Similarly the scores equivalent to the first percentile were: 9 feet 1 inch in the high jump and 36 feet 5 inches in the discus throw. The same table shows that a score of 2 minutes 43 seconds in the half mile or 31 feet 10 inches in the shot put was equal to or better than 75 per cent of all fifteen year olds in the area and that 25 per cent of all fifteen year olds were not able to do a running long jump of 12 feet 7 inches or throw a discus 64 feet. Similar results may be noted for any of the other

age groups in any of the other percentile tables.

One other disadvantage of percentile tables was evident. On the baseline of the normal curve of distribution, percentiles were closely packed near the mean and were spread out towards the ends of the distribution. It was therefore more difficult to raise a percentile if a raw score was already very high or very low. For example, in Table XV, page 82, a raw score of 14 feet 6 inches required only an increase of 2 inches to go from the 45 percentile to the 50. To move from the 95 to the 99 percentile on the same event required a corresponding increase of 1 foot 2 inches.

TABLE XI

PERCENTILE SCORES FOR OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
THIRTEEN YEAR OLD BOYS

Percentiles	880 Yards	Shot-put	100 Yards	Long Jump	High Jump	Discus Throw
99	2:15	31-3	11.3	15-9	4-8	88-0
95	2:32	28-7	12.2	14-8	4-4	79-6
90	2:41	27-2	12.7	14-2	4-3	74-9
85	2:47	26-2	13.1	13-9	4-1	71-9
80	2:52	25-5	13.3	13-6	4-0	69-3
75	2:56	24-9	13.5	13-3	---	67-1
70	3:00	24-2	13.8	13-0	3-11	65-3
65	3:03	23-8	13.9	12-9	3-10	63-7
60	3:06	23-1	14.1	12-7	---	61-10
55	3:09	22-8	14.3	12-5	3-9	60-4
50	3:13	22-1	14.5	12-2	3-8	58-8
45	3:16	21-7	14.6	12-0	---	57-5
40	3:19	21-2	14.8	11-10	---	55-7
35	3:22	20-7	15.0	11-7	3-6	53-9
30	3:26	20-1	15.2	11-5	---	52-2
25	3:29	19-6	15.4	11-2	3-5	50-3
20	3:33	18-10	15.6	10-11	3-4	48-2
15	3:38	18-0	15.9	10-7	3-3	45-7
10	3:45	17-1	16.2	10-3	3-2	42-7
5	3:53	15-7	16.7	9-8	3-1	38-0
1	4:10	13-0	17.6	8-8	2-8	29-5
Mean:	3:13	22-1	14.5	12-2	3-8	58-8
S.D.:	25	47	1.4	18	4.8	151

Number in Sample = 200

TABLE XII

PERCENTILE SCORES FOR OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
FOURTEEN YEAR OLD BOYS

Percentiles	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
99	2:07	36-3	11.0	17-0	4-10	103-4
95	2:23	33-1	11.9	15-10	4-7	100-11
90	2:33	31-4	12.3	15-2	4-5	86-9
85	2:38	30-3	12.6	14-9	4-4	83-0
80	2:43	29-4	12.8	14-5	4-3	79-8
75	2:48	28-7	13.0	14-1	4-2	77-2
70	2:51	27-10	13.2	13-10	4-1	74-9
65	2:55	27-3	13.4	13-8	---	72-8
60	2:58	26-7	13.6	13-5	4-0	70-6
55	3:01	26-1	13.7	13-2	---	68-7
50	3:04	25-6	13.9	12-11	3-11	66-7
45	3:07	24-10	14.0	12-9	3-10	64-6
40	3:10	24-4	14.2	12-6	---	62-7
35	3:14	23-8	14.3	12-3	3-9	60-5
30	3:17	23-1	14.5	12-1	3-8	58-4
25	3:21	22-4	14.7	11-9	---	56-0
20	3:25	21-7	14.9	11-6	3-7	53-3
15	3:30	20-8	15.1	11-2	3-6	50-1
10	3:36	19-6	15.4	10-9	3-5	46-4
5	3:44	17-10	15.9	10-1	3-3	40-6
1	4:02	14-8	16.7	8-11	3-0	29-9
Mean:	3:04	25-6	13.9	12-11	3-11	66-7
S.D.:	25	55	1.2	21	4.9	190

Number in Sample = 268

TABLE XIII

PERCENTILE SCORES FOR OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
FIFTEEN YEAR OLD BOYS

Percentiles	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
99	2:00	39-9	10.3	17-8	5-1	114-3
95	2:17	36-6	11.2	16-6	4-10	103-0
90	2:27	34-9	11.7	15-10	4-8	96-9
85	2:33	33-7	12.0	15-5	4-7	92-8
80	2:39	32-8	12.3	15-1	4-6	89-4
75	2:43	31-10	12.5	14-10	4-5	86-6
70	2:47	31-2	12.7	14-7	4-4	84-0
65	2:50	30-6	12.9	14-4	---	81-10
60	2:54	29-10	13.1	14-1	4-3	79-6
55	2:57	29-3	13.2	13-11	4-2	77-6
50	3:01	28-8	13.4	13-8	---	75-4
45	3:04	28-0	13.6	13-6	4-1	73-2
40	3:07	27-6	13.7	13-3	4-0	71-2
35	3:11	26-9	13.9	13-0	---	68-10
30	3:14	26-2	14.1	12-10	3-11	66-8
25	3:18	25-5	14.3	12-7	3-10	64-2
20	3:23	24-8	14.5	12-3	3-9	61-3
15	3:28	23-8	14.7	11-11	3-8	58-0
10	3:34	22-6	15.1	11-6	3-7	54-0
5	3:44	20-9	15.5	10-11	3-5	47-9
1	4:02	17-6	16.4	9-9	3-1	36-5
Mean:	3:01	28-8	13.4	13-8	4-2	75-4
S.D.:	26	57	1.3	20	4.1	200

Number in Sample = 274

TABLE XIV

PERCENTILE SCORES FOR OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
SIXTEEN YEAR OLD BOYS

Percentiles	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
99	2:17	43-6	10.9	17-11	5-3	107-0
95	2:27	40-1	11.5	16-11	5-0	97-2
90	2:33	38-3	11.8	16-4	4-10	91-10
85	2:37	37-1	12.0	15-11	4-9	88-3
80	2:40	36-1	12.2	15-8	4-8	85-4
75	2:42	35-3	12.3	15-5	4-7	82-10
70	2:45	34-6	12.5	15-2	4-6	80-8
65	2:47	33-10	12.5	15-0	---	78-9
60	2:49	33-1	12.7	14-9	4-5	76-9
55	2:51	32-6	12.8	14-7	4-4	75-0
50	2:53	31-10	12.9	14-5	---	73-1
45	2:55	31-3	13.0	14-2	4-3	71-2
40	2:57	30-7	13.2	14-0	4-2	69-5
35	2:59	29-11	13.3	13-10	---	67-4
30	3:01	29-3	13.4	13-7	4-1	65-6
25	3:03	28-6	13.5	13-4	4-0	63-3
20	3:06	27-8	13.7	13-1	---	60-10
15	3:09	26-8	13.8	12-10	3-11	57-10
10	3:13	25-6	14.0	12-5	3-9	54-4
5	3:18	23-7	14.4	11-11	3-8	49-0
1	3:29	20-3	15.0	10-10	3-4	39-0
Mean:	2:53	31-10	12.9	14-5	4-4	73-1
S.D.:	15	60	0.9	18	4.9	175
Number in Sample = 186						

TABLE XV

PERCENTILE SCORES FOR OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
SEVENTEEN YEAR OLD BOYS

Percentiles	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
99	2:09	45-6	10.2	18-7	5-5	111-0
95	2:22	42-3	10.9	17-5	5-2	100-10
90	2:29	40-6	11.3	16-10	5-0	95-4
85	2:33	39-4	11.5	16-5	4-10	91-9
80	2:37	38-5	11.7	16-1	4-9	88-9
75	2:40	37-7	11.9	15-10	4-8	86-2
70	2:43	36-10	12.0	15-7	4-7	85-0
65	2:46	36-3	12.1	15-4	---	82-0
60	2:48	35-7	12.3	15-1	4-6	79-10
55	2:51	35-0	12.4	14-11	4-5	78-1
50	2:53	34-4	12.5	14-8	4-4	76-1
45	2:56	33-9	12.6	14-6	---	74-2
40	2:58	33-2	12.7	14-3	4-3	72-4
35	3:01	32-6	12.9	14-0	4-2	70-3
30	3:03	31-10	13.0	13-10	4-1	68-4
25	3:06	31-2	13.1	13-7	---	66-1
20	3:09	30-4	13.3	13-3	4-0	60-6
15	3:13	29-5	13.5	12-11	3-9	57-0
10	3:18	28-3	13.7	12-7	3-9	57-0
5	3:25	26-6	14.1	11-11	3-7	51-4
1	3:38	23-3	14.8	10-9	3-3	41-2
Mean:	2:53	34-4	12.5	14-8	4-4	76-1
S.D.:	19	57	1.0	20	5.6	180

Number in Sample = 147

TABLE XVI

PERCENTILE SCORES FOR OKANAGAN HIGH SCHOOL BOYS
FOR SELECTED TRACK AND FIELD EVENTS
EIGHTEEN YEAR OLD BOYS

Percentiles	880 Yards	Shot-Put	100 Yards	Long Jump	High Jump	Discus Throw
99	2:15	44-5	10.7	18-0	5-3	111-11
95	2:27	41-7	11.2	17-1	5-0	101-8
90	2:34	40-0	11.4	16-7	4-10	96-1
85	2:38	38-11	11.6	16-3	4-9	92-5
80	2:41	38-1	11.8	15-11	4-8	89-5
75	2:44	37-4	11.9	15-9	4-7	86-10
70	2:47	36-9	12.0	15-6	4-6	84-7
65	2:49	36-2	12.1	15-4	---	82-7
60	2:51	35-7	12.2	15-2	4-5	80-6
55	2:53	35-1	12.3	15-0	---	78-8
50	2:56	34-6	12.4	14-10	4-4	76-9
45	2:58	33-11	12.5	14-8	4-3	74-9
40	3:00	33-5	12.6	14-6	---	72-11
35	3:02	32-10	12.7	14-3	4-2	70-10
30	3:05	32-3	12.8	14-1	---	68-10
25	3:07	31-8	12.9	13-11	4-1	66-7
20	3:10	30-11	13.0	13-8	4-0	64-0
15	3:14	30-1	13.2	13-5	3-11	61-0
10	3:18	29-0	13.3	13-1	3-10	57-5
5	3:24	27-6	13.5	12-7	3-8	51-9
1	3:36	24-7	14-1	11-7	3-5	41-6
Mean:	2:56	34-6	12.4	14-10	4-4	76-9
S.D.:	17	51	0.7	16	4.6	181

Number in sample = 108

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

The principal objective of this study was to develop an achievement scale based on six track and field events for high school boys in the Okanagan area of British Columbia. The prime criterion was that the results be comparable even though different units of measurement were used. Secondary purposes of the investigation were to determine:

1. percentile norms of performance for each age group for each event,

2. an individual profile chart for achievement in track and field events.

The test sample was selected at random from the physical education classes of the area. Results were obtained from sixteen schools and 1183 boys, tested during their regular physical education classes. The events chosen were the 100 yards and 880 yards; shot-put and discus; long jump and high jump. Classification of results was by age. Normative and comparative tables were calculated for high school boys ages thirteen to eighteen.

Testing was carried out by the physical education teachers following a standardized procedure outlined in a

test manual. Data was then converted for use on the IBM 360 computer at the University of Alberta. Mean and standard deviations were obtained for each event and each age group.

Hexathlon tables were produced for each age group involving a transformation to standard score form. This transformation was to T-scores which are defined as having a mean of fifty and a standard deviation of ten. The tables produced for this part of the study could be used to evaluate, motivate, and compare performances in physical education classes. These same tables could be used to form individual profile charts depicting relative achievement in track and field.

Percentile tables were also produced to facilitate the interpretation of relative position of any result in one of the selected events. Percentile tables were given for each event with a separate table for each of the age groups, thirteen to eighteen inclusive.

The methods used in this study were subject to certain limitations. Testing was carried out by the physical education teachers of sixteen different secondary schools. Statistical treatment followed the basic assumption of normality of distribution of test scores. This assumption was necessary to produce scores that were comparable from one event to another. The results were obtained from actual performance in physical education classes of sixteen schools in the region. There has been no attempt to infer that

these results apply to any other group.

Every effort was made to produce results that were valid, objective, and reliable. Care was taken to explain and discuss the possible interpretation of results. Any achievement scale is worthwhile only if it is clearly understood and in a useful form.

It is hoped that the Hexathlon tables, the individual profile charts, and the percentile tables will be used by the teachers and students of the area. Suggested applications of these results are the following.

1. To evaluate and compare an individual's performance.

2. To motivate students towards self-improvement and to provide incentive for the long hours of practice often necessary in improving performance.

3. To serve as a basis for the implementation of a multi-event competition within the school athletic programs of the area.

4. To serve as a basis for comparison of performance in future years with the possible up-dating or revision of tables and the addition of other events.

II. CONCLUSIONS

The principal objective of the study was to produce a practical method of comparing performances in track and field events. Results were required that were particular to the geographic area and applicable to the ordinary student in a physical education class.

Interpretation of achievement is always important. In 1889, John Galton put the matter very clearly when he wrote:

> A knowledge of the distribution of any quality enables us to ascertain the Rank that man holds among his fellows, in respect to that quality. This is a valuable piece of knowledge in this struggling and competitive world, where success is to the foremost, and failure to the hindmost, irrespective of absolute efficiency. A blurred vision would be above all price to an individual man in a nation of blind men, though it would hardly enable him to earn his bread elsewhere. When the distribution of our faculty has been ascertained, we can tell from the measurement, say of our child, how he ranks among other children in respect to that faculty, whether it be a physical gift, or one of health, or of intellect, or of morals. (47)

Within the limitation of the evaluation procedures and the statistical treatment, conclusions that may be stated from results of this study are:

1. The hexathlon tables, in standard T-score form, were comparable from one event to another.

2. The percentile tables gave an interpretation of relative rank or position of a performance in relation to the normal expected frequency.

3. Mean scores followed a linear relationship in relation to an increase in age up to a certain age. The relationship was linear to age seventeen in the shut-put, and 100 yard sprint events. The relationship was linear to age sixteen in the long jump and high jump events.

III. RECOMMENDATIONS

The previous discussions and conclusions from the results of this study have led the writer to make the

following recommendations:

1. That local norms or regional norms are valuable in the comparison and evaluation of performance and that similar projects be conducted to provide standards in other areas and for other physical skills for both boys and girls.

2. That the results of this study be made available to every physical education teacher in the Okanagan, and any others who may wish to use them.

3. That further investigations be undertaken to ascertain the true shape of the distributions of performance skill results especially in the running events.

4. That the present norms be revised when necessary.

5. That further study be undertaken to determine the effect of motivation and performance in track and field with respect to the developmental curves produced in this study and others.

6. That additional methods or devices of motivating self-improvement among high school students be produced. These would be very worthwhile to the physical education teacher.

7. That the University of Alberta Faculty of Physical Education, with the cooperation of the proper authorities, undertake similar normative or longitudinal studies. The local or regional norms would be valuable to the physical education teachers and could provide a means of drawing together, research and teaching.

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APPENDIX A

SAMPLES OF CORRESPONDENCE

9209 98th Ave.,
Edmonton, Alberta,
Jan., 24, 1967.

To:

Boys Physical Education Teachers

Okanagan Valley Schools Athletic Association.

Dear Sir:

As most of you probably know I have taught for the past six years at the Penticton Secondary School and I am now taking my Masters degree at the University of Alberta.

I would like my thesis to be as practical as possible to all of the physical education teachers of the Okanagan Valley. I would like to establish a decathlon type scoring system for selected track and field items based on percentile norms from performance in physical education classes. Classes would be selected at random and scores from these classes would provide the data for the percentile norms. When completed, these tables would be used in a variety of ways; essentially to motivate, evaluate, and compare performance in a boys physical education class in the Okanagan.

I have permission to speak to you at the convention but the purpose of this letter is to allow you to think of this study and to bring your suggestions and ideas to the convention meeting. The success of this project depends upon the cooperation of everyone involved. I would rather choose another topic if there is not going to be 100% cooperation. All the details will be covered at the convention. If, there, the OVSAA decided to go ahead I will contact the Superintendent, Principal, and Teachers involved as permission must ultimately come from these sources.

Thank you for your trouble and consideration.

Yours truly,

Larrie Grant.

Edmonton, Alberta,
April 5, 1967.

(Letter sent to all Okanagan Principals.
A similar letter was sent to each
District Superintendent.)

Dear

I would like to receive your cooperation and the cooperation of your physical education staff for my thesis research in physical education.

I have taught for the past six years at the Penticton Secondary School but at the present time am now taking my Master of Arts degree at the University of Alberta.

I would like my thesis to be as practical as possible so that it could be of direct use to the physical education teachers of the Okanagan. My thesis is the establishment of a decathlon type scoring table in track and field. It is to be on the six basic track and field events of high school physical education. The decathlon tables will be based on percentile norms from performance in physical education classes. The testing would take place at the end of the track and field unit of instruction, probably in the later part of May. Tests would be conducted by the physical education teacher in the school with my assistance where possible.

Physical education classes would be selected at random. If a class were selected then all boys enrolled in the class would be tested. Testing would take approximately four periods.

I could give you more details if required but I believe your physical education teacher is already aware of the details. If not any question will be answered by return mail. I have received permission to approach you from the Superintendent of Education. The OVSAA endorsed and approved my project at the convention meeting. I would like your permission to continue if any of the physical education classes in your school are chosen for my sample.

I have enclosed two forms for the physical education teachers. Form I is information that is required for sampling as soon as possible. I have this information from some schools but not all. My thesis deals with boys physical education classes only. At the convention meeting I was asked to consider a similar study for the girls. Form II could be given to the girls physical education teacher for her consideration.

I would appreciate an early reply as there is considerable work yet to be completed. This project will have real practical value to every school in the Okanagan. Each school will receive a complete copy of the results.

Yours truly,

Larrie Grant

LG:peb

Reply - typical - District Superintendent of Schools.

Department of Education

Executive Officer
Boards of School Trustees:
S.D.No.12(Grand Forks)
S.D.No.13(Kettle Valley)
S.D.No.14(Southern Okanagan)

Province of
British Columbia
-
DISTRICT SUPERINTENDENT OF SCHOOLS

Box 280
Oliver, B.C.

March 1, 1967

Mr. Larrie Grant
9209 - 98 Avenue
Edmonton, Alberta

Dear Mr. Grant:

This will acknowledge receipt of your letter requesting permission to contact the principals of the secondary schools in School District No. 14 (Southern Okanagan) in regard to your thesis project.

Mr. A. E. Reid, Principal, Southern Okanagan Secondary School, Oliver, B. C. and Mr. W. D. MacLeod, Principal, Osoyoos Elementary-Junior Secondary School Osoyoos, B. C., would be pleased to have you contact them.

Yours very truly,

C. Cuthbert
District Superintendent of Schools

CC:aw

241 Nelson Ave.,
Penticton, B. C.
May 14, 1967.

To all P. E. Teachers:

Please find enclosed a complete administrative booklet for testing of the boy's sample in the normative track and field study for the Okanagan. If there are any questions please contact me. For this to be meaningful to everyone it is necessary that these directions must be followed exactly. I am certain that you may have a better or more practical method of measuring certain events; or would rather have the running events on a cinder track; and certainly use a toe-board for the shot put. Modifications could be made later while still using the resulting tables but please make the changes next year and this year only do it the way prescribed in the manual.

As I suggested, additional information may be useful but it must be considered separate from the sample already selected. Please test only those classes selected as part of the original sample when sending me your official results. Results of handpicked or willing athletes are not meaningful in a normative study of this kind.

It is expected that testing will be completed by the middle of June. If the weather is bad please use your own judgments as to whether it would have any effect on performance. If wind is a factor all events should be performed in a cross wind direction or when the wind will have the least effect.

If results are not picked up by June 20, please send them to me at the following address: University of Alberta, Faculty of Physical Education, Edmonton, Alberta.

Yours truly,

Larrie Grant.

SELECTION OF EVENTS Decathlon Scoring Tables L. Grant

It is not practical to measure performance in all events. Also it is not necessary to have 10. If we include as many events as possible then the individual teacher can select the events he wishes to use for his own class. The tables should be as useful as possible. Naturally the more events chosen will increase the number of class periods required for this project.

Regular Olympic Decathlon	Type of Event	My Selection	Other Possibles
100 meters	Sprint	50 yards*	
		100 yards	75 yards, 220
400 meters		440 yards*	300, 600, 660
1500 meters	Middle distance or distance	1 mile*	880 yards - 2 mile
110 meter high hurdles	Hurdles		80 meters or 110 yd. low hurdles
Long jump	Jumping	Long Jump without take-off board	Long jump, standing long jump
Pole Vault		Triple Jump*	
High Jump		High Jump	Pole vault
Shot-Put	Weight	Shot-Put(4 kilo)	
Discus		Discus	
Javelin			Javelin
		880 yard Steeplechase*	

*These items could be omitted. I believe the six remaining events would require approximately 4 periods.

1. What events would you prefer? (1)_____ (2)_____

(3) _____(4)_____(5)_____

(6) _____(7)_____(8)_____

(9) _____ (10)_____

2. How many periods would you be willing to give?

(a) less than four _____(b) four_____(c)five_____(d) six_____?

APPENDIX B

TESTING MANUAL

OKANAGAN HEXATHLON

Test Administration:

It is important that every teacher follow the directions as closely as possible. This is the only way that the results will be worthwhile.

Administer all tests to all boys included in the sample. If any others are tested please indicate on the recording form. The tests are to be administered in the following order. It is most important that the performance in one event not influence the performance in another (e.g. a tired runner having to jump).

a) Prior to Day I: Forms filled out with students name and age. Facilities must be prepared and equipment ready. If classes are large you will have to be organized.

b) Day I: 880 Yards (trial 1) and Shot Put.
Day II: 100 Yards and Running Long Jump.
Day III: Running High Jump.
Day IV: Discus and 880 Yards (trial 2).

c) After Day IV: Complete testing and recording forms. If not picked up mail the completed forms to:

Faculty of Physical Education
University of Alberta
Edmonton, Alberta.

It is expected that all students will compete in shorts, T. shirt, and running shoes (not spikes).

(2)

Motivation:

Motivation of students will be difficult to standardize but is most important to the study. Suggestions for standardization are:

a) Explain the purpose of the study and answer any questions.

b) Teachers may encourage a rivalry between individuals, classes, and other schools.

c) Once the event is started keep the verbal encouragement to a minimum. It must in no way hinder the recording of results.

d) It is most important that each boy gives his best performance in each event.

Warm-Up:

A warm-up is considered necessary for best results. Warm-up is considered most useful when it is specific to the activity planned. Some suggestions are:

Duration: formal drill 5 minutes

Intensity: This is difficult to standardize from individual to individual and even more difficult from class to class.

Individuals who are not actively participating may be kept active but not performing the event that is being tested except immediately before their performance (10 min.)

Day I jogging, high knee raising, shoulder and upper trunk.
Day II running on the spot, leg exercises.

(3)

Day III running, high leg kicks and leg flexion.
Day IV similar in type to Day I.

100 Yard Run

Equipment:

2 stop-watches calibrated to tenths or a split timer.
a 100 yard straightaway on a grass field with a straight line joining the clearly marked start and finish line.
a whistle for the starter.

Start: A racing crouch start or a standing position may be assumed.

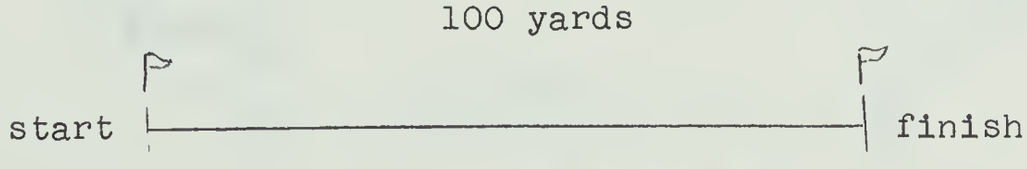
Performance:

Runners are instructed to choose a partner of about the same speed. Students should run in pairs even if the "pacer" is not timed. A student helper may be used as a starter. His commands are; "On your marks" "set" "go". The starter brings his raised arm down sharply and at the same instant shouts "Go". The starter may whistle back false starts.

The runner sprints the 100 yards as fast as he can. One runner on each side of the center line.

Scoring:

The elapsed time from the starting signal to the passage of the runner's chest across the finish line is scored to the nearest tenth of a second. The watch is started when the arm of the starter reaches the belt line. A second trial may be given if time permits.



(4)

880 Yard Run

Equipment:

A marked area on grass according to the diagram at the bottom of the page and a stop watch.

Start:

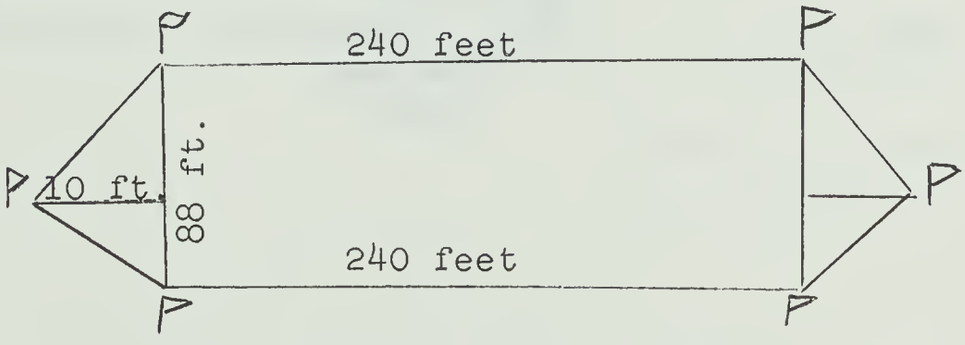
A racing crouch or a standing position may be assumed.

Performance:

Students are divided into two or three groups depending on class size. One group acts as runners and the other as timers, the groups then alternate. Use the same starting commands as the 100 yards. Lap times may be given as the runners pass the starting point. Care should be taken to see that the groups are similar in ability. All the fast runners should not be in one group. The circuit is run four times to make up 880 yards.

Scoring:

The elapsed time from the starting signal to the passage of the runner's chest across the finish line is scored to the nearest second. One watch is used by the teacher for all timing. The student timers are instructed to listen for their partner's time as he crosses the finish line. During the final lap the student timers are instructed to remain silent and listen carefully to the timer. The teacher stands on the finish line and calls out the seconds, as they elapse on the stop watch. The last time called before the runner crosses the finish line is recorded in minutes and seconds. If a second trial is allowed the best time is counted and circled on the recording form.



Construct a rectangle 88 feet by 240 feet. Take the short side and measure 10 feet perpendicularly from the mid-point. Use flags for the turning posts and if possible draw a line connecting the six corners to form a 220 yard track. The boys 880 will then be four laps around this circuit

(5)

Running Long Jump

Equipment:

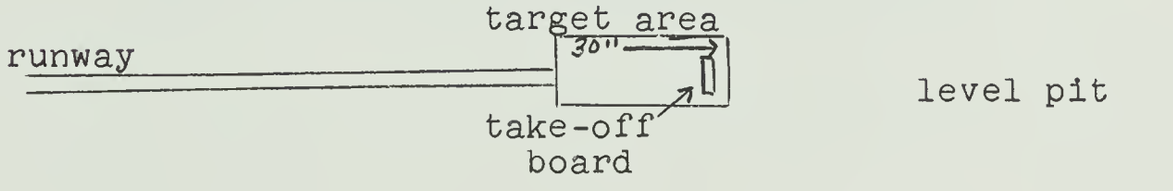
A level jumping pit filled with sand marked out at shown in diagram and a measuring tape.

Performance:

A running approach, a one foot take-off, a flight through the air as far as possible, and a landing constitutes the running long jump event. The event is modified slightly to give a more valid measure of jumping ability. As in the diagram, the take-off area is enlarged to a target area of 30 inches.

Scoring:

Jumps are measured from the actual point of take-off to the point of landing provided the take-off comes within the 30 inch target area. The point of take-off may be determined better if the target area is sprinkled with fine sand or marking compound. This point is determined from the front of the imprint. The point of landing is more difficult to determine. The sand must be raked level after each jump. The point of landing is the nearest break in the landing area made by any part of the body. A straight edge or pencil held at the break in the sand with the score read by the teacher at the point of take-off is considered the best method of measurement. A student is allowed three measurable jumps with the longest jump recorded in feet and inches to the nearest inch.



(6)

Running High Jump

Equipment:

A level take-off area and jumping pit.
A straight regulation size cross-bar and uprights.
A neasuring tape.

Performance:

The running high jump consists of a short running approach, a one foot take-off and a flight over a horizontal bar. Knocking the bar from its supports shall count as a failure.

Scoring:

An individual is eliminated after three successive failures. No passes are allowed. The best jump is measured in inches at the vertical height at the center of the cross-bar, from the ground level to the top edge of the cross-bar. Care must be taken to insure that the ground at the point of measurement is level with the take-off area.

The following changes or modifications have been made to make the high jump event a practical event for a physical education class. Some accuracy is obviously sacrificed. Jumping is to start at thirty inches for all age groups, then increased to thirty-six inches for the second jump. Increases are then to be made in two inch intervals with an accurate measure made everytime the bar is moved.

Any style of high jump is allowed.

(7)

Four Kilogram Shot-Put

Equipment:

A regulation size iron shot weighing exactly 4 kilograms (8 lbs. 13 ounces). (See special note). A measuring tape and a circle marked on grass having a diameter of seven feet and a throwing sector of 65 degrees. Since all schools do not have toe boards they may not be used.

Performance:

The shot shall be put from the shoulder with one hand only. At the time the boy takes his stance in the putting area to commence a put the shot shall touch or be in close proximity to the chin and the hand shall not be dropped below this position during the action of putting. The shot must not be brought behind the line of the shoulders. He must not leave the circle until the shot has touched the ground and then only from the rear of the circle. Small pegs may be used to mark the throws.

Scoring:

"Foul" throws are not measured. The teacher is to check that the shot was "put" from the shoulder and not thrown. Each boy is given three measurable throws and the best recorded to the nearest inch in feet and inches. Measurement is on a straight line from the center of the circle to the point of impact of the shot on the ground. Measurement is from the near edge of the point of impact to the front edge of the circle.

(8)

One Kilogram Discus ***

Equipment:

A regulation size one kilogram discus (not rubber) weighing exactly 1 kilogram (2 pounds 3.274 ounces) (See special note.) Revised as below. A measuring tape and a number of small marking pegs A circle marked on grass having a diameter of 8 feet 2½ inches and a throwing sector of 60 degrees.

Performance:

The discus is thrown with one arm as far as possible so that it lands within the prescribed area. A turn may be used but care must be taken to stay within the circle until the discus lands. A competitor may only leave the circle from the rear and after the discus has landed. Small pegs should be used to mark throws.

Scoring:

Foul throws are not measured. Each boy is given three measurable throws and the best is recorded to the nearest inch in feet and inches. Measurement is on a straight line from the center of the circle to the point of impact of the discus on the ground. Measurement is from the near edge of the point of impact to the front of the circle.

Special Note on All Equipment

Standard shots and discus must be used and care must be taken to see that they are of the correct weight. For example, manufactured shots have been found to vary as much as 6 ounces. Please follow the following directions very carefully:

Take the shot and discus to the local meat market and have it weighed. Accept shots weighing 8 lbs 15 oz. ± 1 oz. Accept discus weighing 2 lbs.3.274 oz. ± 1 oz.

Prior to testing please double check stop watches and tapes as well as measurements for the 100 and 880. All instruments must be completely accurate and reliable.

IF ANY EQUIPMENT IS REQUIRED (shots, discus, stop-watch, measuring tape, etc.) PLEASE CONTACT:

Mr. Larrie Grant
c/o Penticton Secondary School.
Telephone 492-5646

RESULTS WILL ONLY BE USEFUL IF EVERYONE FOLLOWS ALL DIRECTIONS.

*** Revision May 19, 1967.
16, 17, and 18 year olds are to use the official intermediate size discus, exactly 3 pounds 9 ounces ± 1 oz.

APPENDIX C

FORMULA USED FOR CALCULATION OF T-SCORES AND PERCENTILES

FORMULA'S USED IN CALCULATIONS

T-Scores = General Formula

$$\text{T-Score} = 50 + \frac{10(\text{raw score} - \text{mean score})}{\text{standard deviation}}$$

T-Score of 65 = 50 + $1\frac{1}{2}$(standard deviations)
T-Score of 30 = 50 - 2 (standard deviations)

Percentiles

Percentile rank = mean score + Zed score* (standard deviation)

for example:
Percentile rank (80) = mean score + 0.84 (standard deviation)
Percentile rank (40) = mean score - 0.25 (standard deviation)

Note: All means and standard deviations were calculated from the performance scores for each age group and each event.

* Zed scores correspond to the proportionate areas under the unit normal curve and are included below.

Percentile Rank	Zed	Percentile Rank	Zed
99	2.33	45	-0.13
95	1.65	40	-0.25
90	1.28	35	-0.39
85	1.04	30	-0.52
80	0.84	25	-0.67
75	0.67	20	-0.84
70	0.52	15	-1.04
65	0.39	10	-1.28
60	0.25	5	-1.65
55	0.13	1	-2.33
50	0		

APPENDIX D

GROUPED RAW SCORE DATA

FREQUENCY TABLES

*Note: All units are in seconds or inches, whichever is appropriate to the event.

TABLE XVII

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR THIRTEEN YEAR OLD BOYS - 880 YARDS, SHOT-PUT, AND 100 YARD EVENTS

	880 Yards			Shot-Put			100 Yards		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	145.00	148.79	1.	135.00	140.87	1.	12.00	12.16	3.
2	148.79	152.58	1.	140.87	146.75	0.0	12.16	12.33	0.0
3	152.58	156.37	2.	146.75	152.62	0.0	12.33	12.49	0.0
4	156.37	160.17	3	152.62	158.50	0.0	12.49	12.66	6.
5	160.17	163.96	4.	158.50	164.37	2.	12.66	12.82	4.
6	163.96	167.75	10.	164.37	170.25	0.0	12.82	12.99	6.
7	167.75	171.54	10.	170.25	176.12	1.	12.99	13.15	7.
8	171.54	175.33	13.	176.12	182.00	0.0	13.15	13.32	14.
9	175.33	179.12	15.	182.00	187.87	5.	13.32	13.48	7.
10	179.12	182.92	20.	187.87	193.95	2.	13.48	13.65	12.
11	182.92	186.71	12.	193.75	199.62	5.	13.65	13.81	17.
12	186.71	190.50	11.	199.62	205.50	0.0	13.81	13.97	4.
13	190.50	194.29	16.	205.50	211.37	4.	13.97	14.14	18.
14	194.29	198.08	20.	211.37	217.25	8.	14.14	14.30	12.
15	198.08	201.87	10.	217.25	223.12	6.	14.30	14.47	4.
16	201.87	205.67	7.	223.12	229.00	9.	14.47	14.63	6.
17	205.67	209.46	8.	229.00	234.87	8.	14.63	14.80	5.
18	209.46	213.25	4.	234.87	240.75	9.	14.80	14.96	11.
19	213.25	217.04	9.	240.75	246.62	8.	14.96	15.13	11.
20	217.04	220.83	4.	246.62	252.50	13.	15.13	15.29	5.
21	220.83	224.62	6.	252.50	258.37	14.	15.29	15.46	7.
22	224.62	228.42	4.	258.37	264.25	13.	15.46	15.62	10.
23	228.42	232.21	3.	264.25	270.12	10.	15.62	15.79	1.
24	232.21	236.00	1.	270.12	276.00	6.	15.79	15.95	4.
25	236.00	239.79	2.	276.00	281.87	7.	15.95	16.11	8.
26	239.79	243.58	0.0	281.87	287.75	11.	16.11	16.28	2.
27	243.58	247.37	0.0	287.75	293.62	11.	16.28	16.44	0.0
28	247.37	251.17	0.0	293.62	299.50	7.	16.44	16.61	2.
29	251.17	254.96	0.0	299.50	305.37	1.	16.61	16.77	1.
30	254.96	258.75	0.0	305.37	311.25	5.	16.77	16.94	2.
31	258.75	262.54	1.	311.25	317.12	7.	16.94	17.10	2.
32	262.54	266.33	0.0	317.12	323.00	4.	17.10	17.27	2.
33	266.33	270.12	0.0	323.00	328.87	4.	17.27	17.43	0.0
34	270.12	273.92	0.0	328.87	334.75	7.	17.43	17.60	1.
35	273.92	277.71	0.0	334.75	340.63	1.	17.60	17.76	1.
36	277.71	281.50	0.0	340.63	346.50	1.	17.76	17.92	1.
37	281.50	285.29	0.0	346.50	352.37	1.	17.92	18.09	0.0
38	285.29	289.08	0.0	352.37	358.25	3.	18.09	18.25	0.0
39	289.08	292.87	0.0	358.25	364.12	1.	18.25	18.42	0.0
40	292.87	296.67	0.0	364.12	370.00	0.0	18.42	18.58	0.0
41	296.67	300.46	0.0	370.00	375.88	0.0	18.58	18.75	0.0
42	300.46	304.25	1.	375.88	381.75	0.0	18.75	18.91	0.0
43	304.25	308.04	0.0	381.75	387.62	0.0	18.91	19.08	2.
44	308.04	311.83	0.0	387.62	393.50	1.	19.08	19.24	0.0
45	311.83	315.62	0.0	393.50	399.37	2.	19.24	19.41	1.
46	315.62	319.42	0.0	399.37	405.25	1.	19.41	19.57	0.0
47	319.42	323.21	0.0	405.25	411.13	0.0	19.57	19.74	0.0
48	323.21	327.00	1.	411.13	417.00	0.0	19.74	19.90	0.0
49	327.00	330.79	1.	417.00	422.87	1.	19.90	20.06	1.
50	330.79	334.58	0.0	422.87	428.75	0.0	20.06	20.23	0.0
	Skewness = 2.084			Skewness = 0.408			Skewness = 1.129		
	Kurtosis = 8.696			Kurtosis = 0.654			Kurtosis = 2.059		

TABLE XXVIII

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR THIRTEEN YEAR OLD BOYS - LONG JUMP, HIGH JUMP, DISCUS THROW EVENTS

	Long Jump			High Jump			Discus Throw		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	96.00	98.00	2.	36.00	36.54	22.	339.00	356.27	1.
2	98.00	100.00	1.	36.54	37.08	0.0	356.27	373.54	1.
3	100.00	102.00	1.	37.08	37.62	0.0	373.54	390.81	1.
4	102.00	104.00	0.0	37.62	38.17	3.	390.81	408.08	2.
5	104.00	106.00	1.	38.17	38.71	0.0	408.08	425.35	3.
6	106.00	108.00	0.0	38.71	39.25	0.0	425.35	442.62	3.
7	108.00	110.00	2.	39.25	39.79	0.0	442.62	459.90	2.
8	110.00	112.00	4.	39.79	40.33	11.	459.90	477.17	2.
9	112.00	114.00	1.	40.33	40.87	0.0	477.17	494.44	2.
10	114.00	116.00	0.0	40.87	41.42	0.0	494.44	511.71	2.
11	116.00	118.00	2.	41.42	42.50	46.	528.98	546.25	3.
13	120.00	122.00	5.	42.50	43.04	0.0	546.25	563.52	3.
14	122.00	124.00	4.	43.04	43.58	0.0	563.52	580.79	9.
15	124.00	126.00	5.	43.58	44.12	30.	580.79	598.06	10.
16	126.00	128.00	3.	44.12	44.67	0.0	598.06	615.33	7.
17	128.00	130.00	3	44.67	45.21	0.0	615.33	649.87	4.
18	130.00	132.00	5.	45.21	45.75	0.0	632.60	649.87	4.
19	132.00	134.00	2.	45.75	46.29	31.	649.87	667.15	7.
20	134.00	136.00	6.	46.29	46.83	0.0	667.15	684.42	13.
21	136.00	138.00	2.	46.83	47.37	0.0	684.42	701.69	13.
22	138.00	140.00	10.	47.37	47.92	0.0	701.69	718.96	7.
23	140.00	142.00	10.	47.92	48.46	27.	718.96	736.23	16.
24	142.00	144.00	8.	48.46	49.00	0.0	736.23	753.50	9.
25	144.00	146.00	10.	49.00	49.54	0.0	753.50	770.77	9.
26	146.00	148.00	5.	49.54	50.08	17.	770.77	788.04	7.
27	148.00	150.00	13	50.08	50.62	0.0	788.04	805.31	7.
28	150.00	152.00	7.	50.62	51.17	0.0	805.31	822.58	7.
29	152.00	154.00	11.	51.17	51.71	0.0	822.58	839.85	5.
30	154.00	156.00	8.	51.71	52.25	6.	839.85	857.12	3.
31	156.00	158.00	16.	52.25	52.79	0.0	857.12	874.40	4.
32	158.00	160.00	6.	52.79	53.33	0.0	874.40	891.67	2.
33	160.00	162.00	12.	53.33	53.87	0.0	891.67	908.94	6.
34	162.00	164.00	5.	53.87	54.42	4.	908.94	926.21	2.
35	164.00	166.00	5.	54.42	54.96	0.0	926.21	943.48	6.
36	166.00	168.00	3.	54.96	55.50	0.0	943.48	960.75	3.
37	168.00	170.00	1.	55.50	56.04	0.0	960.75	978.02	0.0
38	170.00	172.00	4.	56.04	56.58	0.0	978.02	995.29	1.
39	172.00	174.00	5.	56.58	57.12	0.0	995.29	1012.56	2.
40	174.00	176.00	1.	57.12	57.67	0.0	1012.56	1029.83	0.0
41	176.00	178.00	3.	57.67	58.21	1.	1029.83	1047.10	0.0
42	178.00	180.00	0.0	58.21	58.75	0.0	1047.10	1064.37	0.0
43	180.00	182.00	2.	58.75	59.29	0.0	1081.65	1098.92	0.0
44	182.00	184.00	0.0	59.29	59.83	1.0	1098.92	1116.19	0.0
45	184.00	186.00	1.	59.83	60.37	0.0	1081.65	1098.92	0.0
46	186.00	188.00	2.	60.37	60.92	0.0	1116.19	1133.46	1.
47	188.00	190.00	0.0	60.92	61.46	0.0	1133.46	1150.73	0.0
48	190.00	192.00	0.0	61.46	62.00	0.0	1150.73	1168.00	1.
49	192.00	194.00	1.	62.00	62.54	1.	1168.00	1185.27	1.
50	194.00	196.00	0.0	62.54	63.08	0.0	1185.27	1202.54	0.0
Skewness = -0.403				Skewness = 0.321			Skewness = 0.201		
Kurtosis = 0.472				Kurtosis = 0.823			Kurtosis = 0.348		

TABLE XIX

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR FOURTEEN YEAR OLD BOYS - 880 YARDS, SHOT-PUT, AND 100 YARD EVENTS

No.	880 Yards Interval		Freq.	Shot-Put Interval		Freq.	100 Yard Interval		Freq.
1	137.00	141.56	4.	181.00	187.35	3.	11.20	11.36	1.
2	141.56	146.12	1.	187.35	193.71	2.	11.36	11.52	0.0
3	146.12	150.69	6.	193.71	200.06	2.	11.52	11.68	2.
4	150.69	155.25	5.	200.06	206.42	1.	11.68	11.84	2.
5	155.25	159.81	8.	206.42	212.77	1.	11.84	12.00	3.
6	159.81	164.37	16.	212.77	219.12	4.	12.00	12.16	5.
7	164.37	168.94	12.	219.12	225.48	3.	12.16	12.32	7.
8	168.94	173.50	38.	225.48	231.83	1.	12.32	12.48	7.
9	173.50	178.06	33.	231.83	238.19	7.	12.48	12.64	7.
10	178.06	182.62	27.	238.19	244.54	7.	12.64	12.80	20.
11	182.62	187.19	21.	244.54	250.90	8.	12.80	12.96	8.
12	187.19	191.75	18.	250.90	257.25	9.	12.96	13.12	19.
13	191.75	196.31	24.	257.25	263.60	6.	13.12	13.29	6.
14	196.31	200.87	7.	263.60	269.96	12.	13.29	13.45	20.
15	200.87	205.44	17.	269.96	276.31	20.	13.45	13.61	20.
16	205.44	210.00	4.	276.31	282.67	11.	13.61	13.77	7.
17	210.00	214.56	7.	282.67	289.02	15.	13.77	13.93	23.
18	214.56	219.12	2.	289.02	295.37	19.	13.93	14.09	12.
19	219.12	223.69	2.	295.37	301.73	10.	14.09	14.25	12.
20	223.69	228.25	4.	301.73	308.08	11.	14.25	14.41	16.
21	228.25	232.81	0.0	308.08	314.44	11.	14.41	14.57	3.
22	232.81	237.37	1.	314.44	320.79	6.	14.57	14.73	11.
23	237.37	241.94	3.	320.79	327.15	9.	14.73	14.89	4.
24	241.94	246.50	2.	327.15	333.50	8.	14.89	15.05	7.
25	246.50	251.06	0.0	333.50	339.85	13.	15.05	15.21	15.
26	251.06	255.62	3.	339.85	346.21	8.	15.21	15.37	5.
27	255.62	260.19	0.0	346.21	352.56	8.	15.37	15.53	4.
28	260.19	264.75	0.0	352.56	358.92	12.	15.53	15.69	1.
29	264.75	269.31	1.	358.92	365.27	5.	15.69	15.85	1.
30	269.31	273.87	0.0	365.27	371.62	8.	15.85	16.01	4.
31	273.87	278.44	0.0	371.62	377.98	4.	16.01	16.17	6.
32	278.44	283.00	0.0	377.98	384.33	3.	16.17	16.33	0.0
33	283.00	387.56	0.0	384.33	390.69	4.	16.33	16.49	3.
34	287.56	292.13	0.0	390.69	397.04	3.	16.49	16.65	1.
35	292.13	296.69	0.0	397.04	403.40	1.	16.65	16.81	2.
36	296.69	301.25	1.	403.40	409.75	1.	16.81	16.97	0.0
37	301.25	305.81	0.0	409.75	416.10	3.	16.97	17.14	1.
38	305.81	310.37	0.0	416.10	422.46	1.	17.14	17.30	0.0
39	310.37	314.94	0.0	422.46	428.81	1.	17.30	17.46	0.0
40	314.94	319.50	0.0	428.81	435.17	2.	17.46	17.62	0.0
41	319.50	324.06	0.0	435.17	441.52	0.0	17.62	17.78	1.
42	324.06	328.62	0.0	441.52	447.87	0.0	17.78	17.94	0.0
43	328.62	333.19	0.0	447.87	454.23	0.0	17.94	18.10	0.0
44	333.19	337.75	0.0	454.23	460.58	0.0	18.10	18.26	0.0
45	337.75	342.31	0.0	460.58	466.94	0.0	18.26	18.42	1.
46	342.31	346.87	0.0	466.94	473.29	1.	18.42	18.58	0.0
47	346.87	351.44	0.0	473.29	479.65	1.	18.58	18.74	0.0
48	351.44	356.00	0.0	479.65	486.00	1.	18.74	18.90	0.0
49	356.00	360.56	1.	486.00	492.35	1.	18.90	19.06	1.
50	360.56	365.12	0.0	492.35	498.71	0.0	19.06	19.22	0.0
	Skewness = 2.201			Skewness = 0.491			Skewness = 0.813		
	Kurtosis = 10.567			Kurtosis = 0.525			Kurtosis = 1.291		

TABLE XX

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR FOURTEEN YEAR OLD BOYS - LONG JUMP, HIGH JUMP, DISCUS THROW EVENTS

	Long Jump			High Jump			Discus Throw		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	96.00	98.60	1.	36.00	36.54	12.	242.00	266.96	1.
2	98.60	101.21	0.0	36.54	37.08	0.0	266.96	291.92	0.0
3	101.21	103.81	1.	37.08	37.62	0.0	291.92	316.87	0.0
4	103.81	106.42	1.	37.62	38.17	1.	316.87	341.83	0.0
5	106.42	109.02	2.	38.17	38.71	0.0	341.83	366.79	0.0
6	109.02	111.62	2.	38.71	39.25	0.0	366.79	391.75	2.
7	111.62	114.23	1.	39.25	39.79	0.0	391.75	416.71	0.0
8	114.23	116.83	2.	39.79	40.33	8.	416.71	441.67	1.
9	116.83	119.44	1.	40.33	40.87	0.0	441.67	466.62	3.
10	119.44	122.04	2.	40.87	41.42	0.0	466.62	491.58	2.
11	122.04	124.65	5.	41.42	41.96	0.0	491.58	516.54	6.
12	124.65	127.25	4.	41.96	42.50	35.	516.54	541.50	4.
13	127.25	129.85	6.	42.50	43.04	0.0	541.50	566.46	3.
14	129.85	132.46	12.	43.04	43.58	0.0	566.46	591.42	10.
15	132.46	135.06	4.	43.58	44.12	34.	591.42	616.37	9.
16	135.06	137.67	8.	44.12	44.67	0.0	616.37	641.33	7.
17	137 67	140.27	7.	44.67	45.21	0.0	641.33	666.29	16.
18	140.27	142.87	10.	45.21	45.75	0.0	666.29	691.25	17.
19	142.87	145 48	10.	45.75	46.29	50.	691.25	716.21	17.
20	145.48	148.08	16.	46.29	46.83	0.0	716.21	741.17	11.
21	148.08	150.69	12.	46.83	47.37	0.0	741.17	766.12	14.
22	150.69	153.29	14.	47.37	47.92	0.0	766.12	791.08	16.
23	153.29	155.90	4.	47.92	48.46	41.	791.08	816.04	13.
24	155.90	158.50	22	48.46	49.00	0.0	816.04	841.00	22.
25	158.50	161.10	18.	49.00	49.54	0.0	841.00	865.96	13.
26	161.10	163.71	15.	49.54	50.08	35.	865 96	890.92	7.
27	163.71	166.31	13.	50.08	50.62	0.0	890 92	915.87	10.
28	166.31	168.92	12.	50.62	51.17	0.0	915.87	940.83	6.
29	168.92	171.52	10.	51.17	51.71	0.0	940.83	965.79	10.
30	171.52	174.12	8.	51.71	52.25	18.	965.79	990.75	8.
31	174.12	176.73	9.	52.25	52.79	0.0	990.79	1015.71	6.
32	176.73	179.33	5.	52.79	53.33	0.0	1015.71	1040.67	7.
33	179.33	181.94	1.	53.33	53.87	0.0	1040 67	1065 62	3.
34	181.94	184.54	6.	53.87	54.42	23.	1065.62	1090.58	1.
35	184.54	187.15	6.	54.42	54.96	0 0	1090.58	1115.54	5.
36	187.15	189.75	2.	54.96	55.50	0.0	1115.54	1140.50	3.
37	189.75	192.35	3.	55.50	56.04	5	1140.50	1165.46	3.
38	192.35	194.96	1.	56.04	56.58	0.0	1165.46	1190.42	3.
39	194.96	197.56	5.	56.58	57.12	0.0	1190.42	1215.37	3.
40	197.56	200.17	4.	57.12	57.67	0.0	1215 37	1240.33	2.
41	200.17	202.77	0.0	57.67	58.21	4.	1240.33	1265.29	0.0
42	202.77	205.37	1.	58.21	58.75	0.0	1265.29	1290.25	1.
43	205 37	207.98	1.	58.75	59.29	0.0	1290.25	1315.21	0.0
44	207.98	210.58	0.0	59.29	59.83	0.0	1315.21	1340.17	1.
45	210 58	213.19	0.0	59.83	60.37	1.	1340.17	1365.12	0.0
46	213.19	215.79	0.0	60.37	60.92	0.0	1365.12	1390.08	1.
47	215.79	218.40	0.0	60.92	61.46	0.0	1390 08	1415.04	0.0
48	218.40	221.00	0.0	61.46	62.00	0.0	1415.04	1440.00	0.0
49	221.00	223.60	1.	62.00	62.54	1.	1440.00	1464.96	1.
50	223.60	226.21	0.0	62.54	63.08	0.0	1464.96	1489.92	0.0
	Skewness = -0.002			Skewness = 0.035			Skewness = 0.445		
	Kurtosis = 0.370			Kurtosis = 0.760			Kurtosis = 0.481		

TABLE XXI

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR FIFTEEN YEAR OLD BOYS - 880 YARDS, SHOT-PUT, AND 100 YARDS EVENTS

No.	880 Yards Interval		Freq.	Shot-Put Interval		Freq.	100 Yard Interval		Freq.
1	132.00	136.12	3.	186.00	192.87	1.	11.00	11.27	4.
2	136.12	140.25	5.	192.87	199.75	1.	11.27	11.54	3.
3	140.25	144.37	2.	199.75	206.62	0.0	11.54	11.81	12.
4	144.37	148.50	3.	206.62	213.50	1.	11.81	12.08	11.
5	148.50	152.62	10.	213.50	220.37	2.	12.08	12.35	22.
6	152.62	156.75	11.	220.37	227.25	2.	12.35	12.62	27.
7	156.75	160.87	10.	227.25	234.12	3.	12.62	12.90	12.
8	160.87	165.00	30.	234.12	241.00	1.	12.90	13.17	31.
9	165.00	169.13	22.	241.00	247.87	1.	13.17	13.44	34.
10	169.13	173.25	28.	247.87	254.75	4.	13.44	13.71	32.
11	173.25	177.37	19.	254.75	261.63	2.	13.71	13.98	14.
12	177.37	181.50	14.	261.63	268.50	4.	13.98	14.25	23.
13	181.50	185 62	22.	268.50	275.37	9.	14.25	14.52	13.
14	185.62	189.75	22.	275.37	282.25	11.	14.52	14.79	5.
15	189.75	193.87	10.	282.25	289.12	9.	14.79	15.06	13.
16	193.87	198.00	12.	289.12	296.00	8.	15.06	15.33	3.
17	198.00	202.12	19.	296.00	302.88	6.	15.33	15.60	4.
18	202.12	206.25	5.	302.88	309.75	10.	15.60	15.87	4.
19	206.25	210.38	3.	309.75	316.62	8.	15.87	16.15	3.
20	210.38	214.50	4.	316.62	323.50	11.	16.15	16.42	1.
21	214.50	218.62	3.	323.50	330.37	21.	16.42	16.69	0.0
22	218.62	222.75	1.	330.37	337.25	13.	16.69	16.96	0.0
23	222.75	226.87	4.	337.25	344.12	13.	16.96	17.23	0.0
24	226.87	231.00	0.0	344.12	351.00	11.	17.23	17.50	0.0
25	231.00	235.12	1.	351.00	357.87	14.	17.50	17.77	1.
26	235.12	239.25	1.	357.87	364.75	11.	17.77	18.04	0.0
27	239.25	243.37	0.0	364.75	371.62	2.	18.04	18.31	0.0
28	243.37	247.50	0.0	371.62	378.50	2.	18.31	18.58	0.0
29	247.50	251.62	1.	378.50	385.37	16.	18 58	18.85	0.0
30	251.62	255.75	0.0	385.37	392.25	10.	18.85	19.12	0.0
31	255.75	259.87	1.	392.25	399.12	17.	19.12	19.40	0.0
32	259.87	264.00	2.	399.12	406.00	7.	19.40	19.67	0.0
33	264.00	268.12	2.	406.00	412.87	8.	19.67	19.94	0.0
34	268.12	272.25	1.	412.87	419.75	1.	19.94	20.21	1.
35	272.25	276.37	0.0	419.75	426.62	8.	20.21	20.48	0.0
36	276.37	280.50	2.	426.62	433.50	2.	20.48	20.75	0.0
37	280.50	284.62	0.0	433.50	440.38	3.	20.75	21.02	0.0
38	284.62	288.75	0.0	440.38	447.25	3.	21.02	21.29	0.0
39	288.75	292.88	0.0	447.25	454.12	3.	21.29	21.56	0.0
40	292.88	297.00	0.0	454.12	461.00	2.	21.56	21.83	0.0
41	297.00	301.12	0.0	461.00	467.87	1.	21.83	22.10	0.0
42	301.12	305.25	0.0	467.87	474.75	1.	22 10	22.37	0.0
43	305.25	309.38	0.0	474.75	481.63	0.0	22.37	22.65	0.0
44	309.38	313.50	0.0	481.63	488.50	1.	22.65	22.92	0.0
45	313.50	317.62	0.0	488.50	495.37	0.0	22.92	23.19	0.0
46	317.62	321.75	0.0	495.37	502.25	1.	23.19	23.46	0.0
47	321.75	325.87	0.0	502.25	509.12	0.0	23.46	23.73	0.0
48	325.87	330.00	0.0	509.12	516.00	0.0	23.73	24.00	0.0
49	330.00	334.13	1.	516.00	522.88	1.	24.00	24.27	1.
50	334.13	338.25	0.0	522.88	529.75	0.0	24.27	24.54	0.0
	Skewness = 1.757 Kurtosis = 5.794			Skewness = 0.015 Kurtosis = -0.021			Skewness = 2.619 Kurtosis = 17.105		

TABLE XXII

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR FIFTEEN YEAR OLD BOYS - LONG JUMP, HIGH JUMP, DISCUS THROW EVENTS

No.	Long Jump Interval		Freq.	High Jump Interval		Freq.	Discus Throw Interval		Freq.
1	87.00	89.67	1	36.00	36.58	5.	414.00	435 37	1.
2	89.67	92 33	0.0	36.58	37.17	0.0	435.37	456.75	0.0
3	92.33	95.00	0.0	37 17	37.75	0.0	456.75	478.12	0.0
4	95.00	97.67	0.0	37.75	38.33	0.0	478.12	499.50	0.0
5	97.67	100.33	0.0	38.33	38.92	0.0	499.50	520.88	1.
6	100.33	103.00	0.0	38.92	39.50	0.0	520.88	542.25	3.
7	103.00	105.67	0.0	39.50	40.08	0.0	542 25	563.62	2.
8	105.67	108.33	3.	40.08	40.67	0.0	563.62	585.00	3.
9	108.33	111.00	0.0	40.67	41.25	0.0	585.00	606.37	4.
10	111.00	113.67	0.0	41.25	41.83	0.0	606.37	627.75	3.
11	113.67	116.33	0.0	41.83	42.42	22.	627.75	649.12	3.
12	116.33	119.00	1.	42.42	43.00	0.0	649.12	670.50	3.
13	119.00	121.67	0.0	43.00	43.58	0.0	670.50	691.87	5.
14	121.67	124.33	3.	43.58	44.17	16.	691.87	713.25	14.
15	124.33	127.00	4.	44.17	44.75	0.0	713.25	734.62	12.
16	127.00	129.67	3.	44.75	45.33	0.0	734.62	756.00	14
17	129.67	132.33	4.	45.33	45.92	0.0	756.00	777.37	16.
18	132.33	135.00	1.	45.92	46.50	35.	777.37	798.75	9.
19	135.00	137.67	5.	46.50	47.08	0.0	798.75	820.13	11.
20	137.67	140.33	7.	47.08	47.67	0.0	820.13	841.50	18.
21	140.33	143.00	6.	47.67	48.25	58.	841.50	862.87	10.
22	143.00	145.67	7.	48.25	48.83	0.0	862.87	884.25	12.
23	145.67	148.33	10.	48.83	49.42	0.0	884.25	905.62	11.
24	148.33	151.00	4.	49.42	50.00	0.0	905.62	927.00	10.
25	151.00	153.67	18.	50.00	50.58	40.	927.00	948.38	12.
26	153.67	156.33	16.	50.58	51.17	0.0	948.38	969.75	8.
27	156.33	159.00	9.	51.17	51.75	0.0	969.75	991.12	6.
28	159.00	161.67	17.	51.75	52.33	31.	991.12	1012.50	5.
29	161.67	164.33	12.	52.33	52.92	0.0	1012.50	1033.88	8.
30	164.33	167.00	15.	52.92	53.50	0.0	1033.88	1055.25	9.
31	167.00	169.67	14.	53.50	54.08	29.	1055.25	1076.62	7.
32	169.67	172.33	21	54.08	54.67	0.0	1076.62	1098.00	11.
33	172.33	175.00	11	54.67	55.25	0.0	1098.00	1119.37	4.
34	175.00	177.67	12.	55.25	55.83	0.0	1119.37	1140.75	3.
35	177.67	180.33	14.	55.83	56.42	15.	1140.75	1162.12	2.
36	180.33	183.00	10.	56.42	57.00	0.0	1162.12	1183.50	7.
37	183.00	185.67	6.	57.00	57.58	0.0	1183.50	1204.87	2.
38	185.67	188.33	8.	57.58	58.17	10.	1204.87	1226.25	2.
39	188.33	191.00	6.	58.17	58.75	0.0	1226.25	1247.62	1.
40	191.00	193.67	9.	58.75	59.33	0.0	1247.62	1269.00	3.
41	193.67	196.33	4.	59.33	59.92	0.0	1269.00	1290.37	3.
42	196.33	199.00	2.	59.92	60.50	7.	1290.37	1311.75	2.
43	196.33	199.00	2.	59.92	60.50	7.	1311.75	1333.12	2.
44	201.67	204.33	1.	61.08	61.67	0.0	1333.12	1354.50	6.
45	204.33	207.00	3.	61.67	62.25	5.	1354.50	1375.88	3.
46	207.00	209.67	1.	62.25	62.83	0.0	1375.88	1397.25	0.0
47	209.67	212.33	1.	62.83	63.42	0.0	1397.25	1418.62	0.0
48	212.33	215.00	0.0	63.42	64.00	0.0	1418.62	1440.00	0.0
49	215.00	217.67	2.	64.00	64.58	1.	1440.00	1461.37	1.0
50	217.67	220.33	0.0	64.58	65.17	0.0	1461.37	1482.75	0.0
	Skewness = -0.331			Skewness = 0.148			Skewness = 0.510		
	Kurtosis = 0.829			Kurtosis - 0.944			Kurtosis = -0.113		

TABLE XXIII

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR SIXTEEN YEAR OLD BOYS - 880 YARDS, SHOT-PUT, AND 100 YARD EVENTS

	880 Yards			Shot Put			100 Yards		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	136.00	137.94	1.	218.00	225.29	1.	11.00	11.14	1.
2	137.94	139.88	0.0	225.29	232.58	0.0	11.14	11.27	2.
3	139.88	141.81	2.	232.58	239.87	0.0	11.27	11.41	1.
4	141.81	143.75	1.	239.87	247.17	1.	11.41	11.54	4.
5	143.75	145.69	6.	247.17	254.46	2.	11.54	11.68	1.
6	145.69	147.62	0.0	254.46	261.75	0.0	11.68	11.81	4.
7	147.62	149.56	2.	261.75	269.04	1.	11.81	11.95	3.
8	149.56	151.50	6.	269.04	276.33	2.	11.95	12.08	6.
9	151.50	153.44	2.	276.33	283.62	3.	12.08	12.22	16.
10	153.44	155.37	5.	283.62	290.92	3.	12.22	12.35	11.
11	155.37	157.31	1.	290.92	298.21	1.	12.35	12.49	9.
12	157.31	159.25	7.	298.21	305.50	1.	12.49	12.62	21.
13	159.25	161.19	7.	305.50	312.79	3.	12.62	12.76	5.
14	161.19	163.13	6.	312.79	320.08	10.	12.76	12.90	10.
15	163.13	165.06	8.	320.08	327.37	4.	12.90	13.03	23.
16	165.06	167.00	3.	327.37	334.67	7.	13.03	13.17	4.
17	167.00	168.94	14.	334.67	341.96	10.	13.17	13.30	12.
18	168.94	170,87	14.	341.96	349.25	5.	13.30	13.44	8.
19	170.87	172.81	12.	349.25	356.54	11.	13.44	13.57	6.
20	172.81	174.75	11.	356.54	363.83	8.	13.57	13.71	9.
21	174.75	176.69	11.	363.83	371.12	6.	13.71	13.84	4.
22	176.69	178.62	8.	371.12	378.42	12.	13.84	13.98	5.
23	178.62	180.56	10.	378.42	385.71	7.	13.98	14.11	6.
24	180.56	182.50	2.	385.71	393.00	14.	14.11	14.25	3.
25	182.50	184.44	4.	393.00	400.29	6.	14.25	14.39	2.
26	184.44	186.38	9.	400.29	407.58	5.	14.39	14.52	2.
27	186.38	188.31	4.	407.58	414.87	7.	14.52	14.66	1.
28	188.31	190.25	9.	414.87	422.17	4.	14.66	14.79	2.
29	190.25	192.19	3.	422.17	429.46	9.	14.79	14.93	1.
30	192.19	194.12	0.0	429.46	436.75	5.	14.93	15.06	1.
31	194.12	196.06	0.0	436.75	444.04	11.	15.06	15.20	1.
32	196.06	198.00	2.	444.04	451.33	4.	15.20	15.33	0.0
33	198.00	199.94	2.	451.33	458.62	5.	15.33	15.47	0.0
34	199.94	201.87	2.	458.62	465.92	5.	15.47	15.60	1.
35	201.87	203.81	2.	465.92	473.21	6.	15.60	15.74	0.0
36	203.81	204.75	0.0	473.21	480.50	0.0	15.74	15.87	0.0
37	205.75	207.69	2.	480.50	487.79	0.0	15.87	16.01	0.0
38	207.69	209.62	0.0	487.79	495.08	3.	16.01	16.15	0.0
39	209.62	211.56	0.0	495.08	502.37	0.0	16.15	16.28	0.0
40	211.56	213.50	0.0	502.37	509.67	1.	16.28	16.42	0.0
41	213.50	215.44	0.0	509.67	516.96	0.0	16.42	16.55	0.0
42	215.44	217.37	0.0	516.96	524.25	0.0	16.55	16.69	0.0
43	217.37	219.31	0.0	524.25	531.54	0.0	16.69	16.82	0.0
44	219.31	221.25	1.	531.54	538.83	0.0	16.82	16.96	0.0
45	221.25	223.19	0.0	538.83	546.12	0.0	16.96	17.09	0.0
46	223.19	225.12	0.0	546.12	553.42	1.	17.09	17.23	0.0
47	225.12	227.06	0.0	553.42	560.71	0.0	17.23	17.36	0.0
48	227.06	229.00	0.0	560.71	568.00	1.	17.36	17.50	0.0
49	229.00	230.94	1.	568.00	575.29	1.	17.50	17.64	1.
50	230.94	232.87	0.0	575.29	582.58	0.0	17.64	17.77	0.0
	Skewness = 0.296			Skewness = 0.138			Skewness = 1.010		
	Kurtosis = 1.241			Kurtosis = 0.341			Kurtosis = 3.775		

TABLE XXIV

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR SIXTEEN YEAR OLD BOYS - LONG JUMP, HIGH JUMP, DISCUS THROW EVENTS

	Long Jump			High Jump			Discus Throw		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	112.00	114.46	1.	36.00	36.54	1.	482.00	502.46	1.
2	114.46	116.92	0.0	36.54	37.08	0.0	502.46	522.92	2.
3	116.92	119.37	0.0	37.08	37.62	0.0	522.92	543.37	1.
4	119.37	121.82	0.0	37.62	38.17	0.0	543.37	563.83	1.
5	121.83	124.29	0.0	38.17	38.71	0.0	563.83	584.29	2.
6	124.29	126.75	0.0	38.71	39.25	0.0	584.29	604.75	1.
7	126.75	129.21	1.	39.25	39.79	0.0	604.75	625.21	5.
8	129.21	131.67	0.0	39.79	40.33	1.	625.21	645.67	3.
9	131.67	134.12	0.0	40.33	40.87	0.0	645.67	666.12	5.
10	134.12	136.58	2.	40.87	41.42	0.0	666.12	686.58	4.
11	136.58	139.04	0.0	41.42	41.92	0.0	686.58	707.04	4.
12	139.04	141.50	3.	41.96	42.50	4.	707.04	727.50	11.
13	141.50	143.96	2.	42.50	43.04	0.0	727.50	747.96	2.
14	143.96	146.42	6.	43.04	43.58	0.0	747.96	768.42	7.
15	146.42	148.87	1.	43.58	44.12	9.	768.42	788.87	8.
16	148.87	151.33	5.	44.12	44.67	0.0	788.87	809.33	13.
17	151.33	153.79	4.	44.67	45.21	0.0	809.33	829.79	13.
18	153.79	156.25	10.	45.21	45.75	0.0	829.79	850.25	2.
19	156.25	158.71	4.	45.75	46.29	13.	850.25	870.71	8.
20	158.71	161.17	7.	46.29	46.83	0.0	870.71	891.17	10.
21	161.17	163.62	4.	46.83	47.37	0.0	891.17	911.62	9.
22	163.62	166.08	12.	47.37	47.92	0.0	911.62	932.08	7.
23	166.08	168.54	10.	47.92	48.46	27.	932.08	952.54	6.
24	168.54	171.00	16	48.46	49.00	0.0	952.54	973.00	8.
25	171.00	173.46	15.	49.00	49.54	0.0	973.00	993.46	6.
26	173.46	175.92	13.	49.54	50.08	35.	993.46	1013.92	9.
27	175.92	178.37	8.	50.08	50.62	0.0	1013.92	1034.37	5.
28	178.37	180.83	4.	50.62	51.17	0.0	1034.37	1054.83	7.
29	180.83	183.29	10.	51.17	51.71	0.0	1054.83	1075.29	5.
30	183.29	185.75	3.	51.71	52.25	27.	1075.29	1095.75	1.
31	185.75	188.21	8.	52.25	52.79	0.0	1095.75	1116.21	5.
32	188.21	190.67	5.	52.79	53.33	0.0	1116.21	1136.67	1.
33	190.67	193.12	12.	53.33	53.87	0.0	1136.67	1157.12	1.
34	193.12	195.58	2.	53.87	54.42	22.	1157.12	1177.58	1.
35	195.58	198.04	3.	54.42	54.96	0.0	1177.58	1198.04	4.
36	198.04	200.50	4.	54.96	55.50	0.0	1198.04	1218.50	1.
37	200.50	202.96	1.	55.50	56.04	17.	1218.50	1238.96	2.
38	202.96	205.42	2.	56.04	56.58	0.0	1238.96	1259.42	1.
39	205.42	207.87	1.	56.58	57.12	0.0	1259.42	1279.87	0.0
40	207.87	210.33	2.	57.12	57.67	0.0	1279.87	1300.33	1.
41	210.33	212.79	1.	56.67	58.21	15.	1300.33	1320.79	1.
42	212.79	215.25	2.	58.21	58.75	0.0	1320.79	1341.25	1.
43	215.25	217.71	1.	58.75	59.29	0.0	1341.25	1361.71	0.0
44	217.71	220.17	0.0	59.29	59.83	0.0	1361.71	1382.17	0.0
45	220.17	222.62	0.0	59.83	60.37	8.	1382.17	1402.62	0.0
46	222.62	225.08	0.0	60.37	60.92	0.0	1402.62	1423.08	0.0
47	225.08	227.54	0.0	60.92	61.46	0.0	1423.08	1443.54	0.0
48	227.54	230.00	0.0	61.46	62.00	0.0	1443 54	1464.00	0.0
49	230.00	232.46	1.	62.00	62.54	7.	1464.00	1484.46	1.
50	232.46	234.92	0.0	62.54	63.08	0.0	1484.46	1504.92	0.0
	Skewness = 0.070			Skewness = 0.022			Skewness = 0.364		
	Kurtosis = 0.882			Kurtosis = 0.446			Kurtosis = 0.240		

TABLE XXV

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR SEVENTEEN YEAR OLD BOYS - 880 YARDS, SHOT PUT, AND 100 YARD EVENTS

	880 Yards			Shot Put			100 Yards		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	141.00	143.81	7.	209.00	217.65	1.	10.70	10.82	2.
2	143.81	146.62	0.0	217.65	226.29	0.0	10.82	10.95	1.
3	146.62	149.44	2.	226.29	234.94	0.0	10.95	11.07	1.
4	149.44	152.25	3.	234.94	243.58	0.0	11.07	11.19	2.
5	152.25	155 06	4.	243.58	252.23	0.0	11.19	11.31	7.
6	155.06	157.87	5.	252.23	260.87	1.	11.31	11.44	3.
7	157.87	160.69	13.	260.87	269.52	0.0	11.44	11.56	4.
8	160.69	163.50	14.	269.52	278.17	0.0	11.56	11.68	3.
9	163.50	166.31	12.	278.17	286.81	2.	11.68	11.81	7.
10	166.31	169.13	9.	286.81	295.46	0.0	11.81	11.93	9.
11	169.13	171.94	8.	295.46	304.10	1.	11.53	12.05	19.
12	171.94	174.75	10.	304.10	312.75	0.0	12.05	12.17	9.
13	174.75	177.56	10.	312.75	321.40	1.	12.17	12.30	2.
14	177.56	180.37	14.	321.40	330.04	4.	12.30	12.42	14.
15	180.37	183.19	6.	330.04	338.69	1.	12.42	12.54	6.
16	183 19	186.00	3.	338.69	347.33	3.	12.54	12.67	5.
17	186 00	188.81	3.	347.33	355.98	4.	12.67	12.79	2.
18	188.81	191.62	2.	355.98	364.62	5.	12.79	12.91	7.
19	191.62	194.44	6.	364.62	373.27	9.	12.91	13.04	12.
20	194.44	197.25	1.	373.27	381.92	11.	13.04	13.16	4.
21	197.25	200.06	5.	381.92	390.56	7.	13.16	13.28	2.
22	200.06	202.87	0.0	390.56	399.21	10.	13.28	13.40	4.
23	202.87	205.69	3.	399.21	407.85	10.	13.40	13.53	1.
24	205.79	208.50	2.	407.85	416.50	6.	13.53	13.65	2.
25	208.50	211.31	1.	416.50	425.15	13.	13.65	13.77	3.
26	211.31	214.12	0.0	425.15	433.79	9.	13.77	13 90	1.
27	214.12	216.94	0.0	433.79	442.44	9.	13.90	14.02	6.
28	216.94	219.75	0.0	442.44	451.08	10.	14.02	14.14	1.
29	219.75	222.56	1.	451.08	459.73	8.	14.14	14.26	0.0
30	222.56	225.37	0.0	459.73	468.37	3.	14 26	14.39	0.0
31	225.37	228.19	0.0	468.37	477.02	3.	14.39	14.51	3.
32	228.19	231.00	0.0	477.02	485.67	3.	14.51	14.63	0.0
33	231 00	233.81	0.0	485 67	494.31	4.	14.63	14.76	0.0
34	233.81	236.62	1.	494.31	502.96	1.	14.76	14.88	0.0
35	236.62	239.44	1.	502.96	511.60	1.	14.88	15.00	3.
36	239.44	242.25	0.0	511.60	520.25	2.	15.00	15.12	1.
37	242.25	245.06	0.0	520.25	528.90	1.	15.12	15.25	0.0
38	245.06	247.87	0.0	528.90	537.54	2.	15.25	15.37	0.0
39	247.87	250.69	0.0	537.54	546.19	0.0	15.37	15.49	0.0
40	250.69	253.50	0.0	546.19	554 83	0.0	15.49	15.62	0.0
41	253.50	256.31	0.0	554.83	263.48	0.0	15.62	15.74	0.0
42	256.31	259.12	0.0	563.48	572.12	0.0	15.74	15.86	0.0
43	259.12	261.94	0.0	572.12	580.77	1.	15 86	15.99	0.0
44	261.94	264.75	0.0	580 77	589.42	0.0	15 99	16.11	0.0
45	264.75	267.56	0.0	589.42	598.06	0.0	16.11	16.23	0.0
46	267.56	270.37	0.0	598.06	606.71	0.0	16.23	16.35	0.0
47	270.37	273.19	0.0	606.71	615.35	0.0	16.35	16.48	0.0
48	273.19	276.00	0.0	615.35	624.00	0.0	16.48	16.60	0.0
49	276.00	278.81	1.	624.00	632.65	1.	16.60	16.72	1.
50	278.81	281.62	0.0	632.65	641.29	0 0	16.72	16.85	0.0
	Skewness = 1.648			Skewness = 0.079			Skewness = 1.039		
	Kurtosis = 6.164			Kurtosis = 1.924			Kurtosis = 2.029		

TABLE XXVI

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR SEVENTEEN YEAR OLD BOYS - LONG JUMP, HIGH JUMP, DISCUS THROW EVENTS

	Long Jump			High Jump			Discus Throw		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	99.00	101.60	1.	36.00	36.63	2.	468.00	491.00	1.
2	101.60	104.21	0.0	36.63	37.25	0.0	491.00	514.00	1.
3	104.21	106.81	0.0	37.25	37.87	0.0	514.00	537.00	0.0
4	106.81	109.42	0.0	37.87	38.50	0.0	537.00	560.00	1.
5	109.42	112.02	0.0	38.50	39.12	0.0	560.00	583.00	2.
6	112.02	114.62	0.0	39.12	39.75	0.0	583.00	606.00	2.
7	114.62	117.23	0.0	39.75	40.37	0.0	606.00	629.00	2.
8	117.23	119.83	0.0	40.37	41.00	0.0	629.00	652.00	0.0
9	119.83	122.44	0.0	41.00	41.62	0.0	652.00	675.00	2.
10	122.44	125.04	1.	41.62	42.25	4.	675.00	698.00	5.
11	125.04	127.65	0.0	42.25	42.88	0.0	698.00	721.00	1.
12	127.65	130.25	1.	42.88	43.50	0.0	721.00	744.00	3.
13	130.25	132.85	0.0	43.50	44.12	8.	744.00	767.00	10.
14	132.85	135.46	0.0	44.12	44.75	0.0	767.00	790.00	4.
15	135.46	138.06	1.	44.75	45.37	0.0	790.00	813.00	3.
16	138.06	140.67	0.0	45.37	46.00	0.0	813.00	836.00	8.
17	140.67	143.27	1.	46.00	46.62	4.	836.00	859.00	12.
18	143.27	145.87	1.	46.62	47.25	0.0	859.00	882.00	5.
19	145.87	148.48	5.	46.25	47.88	0.0	882.00	905.00	7.
20	148.48	151.08	4.	47.88	48.50	16.	905.00	928.00	9.
21	151.08	153.69	2.	48.50	49.13	0.0	928.00	951.00	12.
22	153.69	156.29	3.	49.13	49.75	0.0	951.00	974.00	6.
23	156.29	158.90	5.	49.75	50.37	34.	974.00	997.00	11.
24	158.90	161.50	7.	50.37	51.00	0.0	997.00	1020.00	9.
25	161.50	164.10	10.	51.00	51.62	0.0	1020.00	1043.00	6.
26	164.10	166.71	4.	51.62	52.25	8.	1043.00	1066.00	2.
27	166.71	169.31	7.	52.25	52.87	0.0	1066.00	1089.00	0.0
28	169.31	171.92	8.	52.87	53.50	0.0	1089.00	1112.00	5.
29	171.92	174.52	13.	53.50	54.13	31.	1112.00	1135.00	3.
30	174.52	177.12	8.	54.13	54.75	0.0	1135.00	1158.00	4.
31	177.12	179.73	6.	54.75	55.38	0.0	1158.00	1181.00	1.
32	179.73	182.33	5.	55.38	56.00	0.0	1181.00	1204.00	4.
33	182.33	184.94	5.	56.00	56.62	16.	1204.00	1227.00	1.
34	184.94	187.54	6.	56.62	56.25	0.0	1227.00	1250.00	0.0
35	187.54	190.15	4.	57.25	57.87	0.0	1250.00	1273.00	0.0
36	190.15	192.75	2.	57.87	58.50	6.	1273.00	1296.00	1.
37	192.75	195.35	9.	58.50	59.12	0.0	1296.00	1319.00	0.0
38	195.35	197.96	4.	59.12	59.75	0.0	1319.00	1342.00	0.0
39	197.96	200.56	4.	59.75	60.38	5.	1342.00	1365.00	0.0
40	200.56	203.17	6.	60.38	61.00	0.0	1365.00	1388.00	1.
41	203.17	205.77	3.	61.00	61 63	0.0	1388.00	1411.00	0.0
42	205.77	208.37	5.	61.63	62.25	6.	1411.00	1434.00	0.0
43	208.37	210.98	1.	62.25	62.87	0.0	1434.00	1457.00	0.0
44	210.98	213.58	3.	62.87	63.50	0.0	1457.00	1480.00	0.0
45	213.58	216.19	0.0	63.50	64.12	5.	1480.00	1503.00	0.0
46	216.19	218.79	0.0	64.12	64.75	0.0	1503.00	1526.00	0.0
47	218.79	221.40	1.	64.75	65.37	0.0	1526.00	1549.00	0.0
48	221.40	224.00	0.0	65.37	66.00	0.0	1549.00	1572.00	1.
49	224.00	226.60	1.	66.00	66.63	2.	1572.00	1595.00	1.
50	226.60	229.21	0.0	66.63	67.25	0.0	1595.00	1618.00	0.0
	Skewness = -0.300			Skewness = 0.051			Skewness = 0.519		
	Kurtosis = 0.911			Kurtosis = 0.668			Kurtosis = 1.633		

TABLE XXVII

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR EIGHTEEN YEAR OLD BOYS - 880 YARDS, SHOT-PUT, 100 YARD EVENTS

No.	880 Yards Interval		Freq.	Shot-Put Interval		Freq.	100 yard Interval		Freq.
1	145.00	147.33	3.	281.00	286.08	1.	10.50	10.60	1.
2	147.33	149.67	5.	286.08	291.17	0.0	10.60	10.69	0.0
3	149.67	152.00	0.0	291.17	296.25	0.0	10.69	10.79	0.0
4	152.00	154.33	3.	296.25	301.33	1.	10.79	10.88	0.0
5	154.33	156.67	2.	301.33	306.42	0.0	10.88	10.98	1.
6	156.67	159.00	2.	306.42	311.50	0.0	10.98	11.07	2.
7	159.00	161.33	8.	311.50	316.58	1.	11.07	11.17	1.
8	161.33	163.67	2.	316.58	321.67	2.	11.17	11.27	2.
9	163.67	166.00	8.	321.67	326.75	3.	11.27	11.36	1.
10	166.00	168.33	5.	326.75	331.83	0.0	11.36	11.46	2.
11	168.33	170.67	3.	331.83	336.92	1.	11.46	11.55	1.
12	170.67	173.00	1.	336.92	342.00	3.	11.55	11.65	1.
13	173.00	175.33	13.	342.00	347.08	0.0	11.65	11.75	5.
14	175.33	177.67	6.	347.08	352.17	2.	11.75	11.84	2.
15	177.67	180.00	7.	352.17	357.25	2.	11.84	11.94	8.
16	180.00	182.33	4.	357.25	362.33	0.0	11.94	12.03	15.
17	182.33	184.67	5.	362.33	367.42	1.	12.03	12.13	7.
18	184.67	187 00	9.	367.42	372.50	4.	12.13	12.22	6.
19	187.00	189.33	5.	372.50	377.58	5.	12.22	12.32	3.
20	189.33	191.67	3.	377.58	382.67	5.	12.32	12.42	5.
21	191.67	194.00	2.	382.67	387.75	2.	12.42	12.51	5.
22	194.00	196.33	3.	387.75	392.83	2.	12.51	12.61	2.
23	196.33	198.67	1.	392.83	397.92	3.	12.61	12.70	2.
24	198.67	201.00	3.	397.92	403.00	4.	12 70	12.80	0.0
25	201.00	203.33	1	403.00	408.08	6.	12.80	12.90	6.
26	203.33	205.67	0.0	408.08	413.17	3.	12.90	12.99	2.
27	205.67	208.00	0.0	413.17	418.25	3	12.90	13 09	8.
28	208.00	210.33	0.0	418.25	423.33	4.	13.09	13.18	5.
29	210.33	212.67	0 0	423.33	428.42	5.	13.18	13.28	2.
30	212.67	215.00	1.	428.42	433.50	4.	13.28	13.37	3.
31	215.00	217.33	1.	433 50	438.58	2.	13.37	13.47	1.
32	217.33	219.67	0.0	438.58	443.67	4.	13.47	13.57	2.
33	219.67	222.00	0.0	443.67	448.75	9.	13.57	13 66	2.
34	222.00	224.33	1.	448.75	453.83	5.	13.66	13.76	2.
35	224.33	226.67	0.0	453.83	458.92	4.	13.76	13.85	1.
36	226.67	229.00	0.0	458.92	464.00	2.	13.85	13.95	0.0
37	229.00	231.33	0.0	464.00	469.08	2.	13.95	14.05	1.0
38	231.33	233.67	0.0	469.08	474.17	0.0	14.05	14.14	0.0
39	233.67	236.00	0.0	474.17	479.25	2.	14.14	14.24	0.0
40	236.00	238.33	0.0	479.25	484.33	0.0	14.24	14.33	0.0
41	238.33	240.67	0.0	484.33	489.42	3.	14 33	14.43	0.0
42	240.67	243.00	0.0	489.42	494.50	1.	14.43	14.52	0.0
43	243.00	245.33	0.0	494.50	499.58	1.	14.52	14.62	0.0
44	245.33	247.67	0.0	499.58	504.67	1.	14 63	14.72	0.0
45	247.67	250.00	0.0	504 67	509.75	1	14.72	14.81	0.0
46	250.00	252.33	0.0	509.75	514.83	2.	14.81	14.91	0.0
47	252.33	254.67	0.0	514.83	519.92	1.	14.91	15.00	0.0
48	254.67	257.00	0.0	519.92	525.00	0.0	15.00	15.10	0.0
49	257.00	259.33	1.	525.00	530.08	1.	15.10	15.20	1.
50	259 33	261.67	0.0	530.08	535.17	0.0	15.20	15.29	0.0
	Skewness = 1.100			Skewness =-0.207			Skewness = 0.368		
	Kurtosis = 4.155			Kurtosis =-0.101			Kurtosis = 1.491		

TABLE XXVIII

FREQUENCY DISTRIBUTION OF GROUPED RAW SCORE DATA FOR EIGHTEEN YEAR OLD BOYS - LONG JUMP, HIGH JUMP, DISCUS THROW EVENTS

	Long Jump			High Jump			Discus Throw		
No.	Interval		Freq.	Interval		Freq.	Interval		Freq.
1	117.00	119.31	1.	36.00	36.54	1.	532.00	552.67	2.
2	119.31	121.62	0.0	36.54	37.08	0.0	552.67	573.33	0.0
3	121.62	123.94	0.0	37.08	37.62	0.0	573.33	594.00	0.0
4	123.94	126.25	0.0	37.62	38.17	0.0	594.00	614.67	2.
5	126.25	128.56	0.0	38.17	38.71	0.0	614.67	635.33	1.
6	128.56	130.87	0.0	38.71	39.25	0.0	635.33	656.00	3.
7	130.87	133.19	0.0	39.25	39.79	0.0	656.00	676.67	1.
8	133.19	135.50	0.0	39.79	40.33	2.	676.67	697.33	2.
9	135.50	137.81	0.0	40.33	40.87	0.0	697.33	718.00	1.
10	137.81	140.12	0.0	40.87	41.42	0.0	718.00	738.67	4.
11	140.12	142.44	0.0	41.42	41.96	0.0	738.67	759.33	2.
12	142.44	144.75	0.0	41.96	42.50	0.0	759.33	780.00	4.
13	144.75	147.06	1.	42.50	43.04	0.0	780.00	800.67	6.
14	147.06	149.37	1.	43.04	43.58	0.0	800.67	821.33	6.
15	149.37	151.69	1.	43.58	44.12	4.	821.33	842.00	3.
16	151.69	154.00	0.0	44.12	44.67	0.0	842.00	862.67	4.
17	154.00	156.31	0.0	44.67	45.21	0.0	862.67	883.33	9.
18	156.31	158.62	4.	45.21	45.75	0.0	883.33	904.00	7.
19	158.62	160.94	8.	45.75	46.29	7.	904.00	924.67	4.
20	160.94	163.25	8.	46.29	46.83	0.0	924.67	945.33	4.
21	163.25	165.56	5.	46.83	47.37	0.0	945.33	966.00	4.
22	165.56	167.87	4.	46.37	47.92	0.0	966.00	986.67	3.
23	167.87	170.19	6.	47.92	48.46	6.	986.67	1007.33	3.
24	170.19	172.50	3.	48.46	49.00	0.0	1007.33	1028.00	5.
25	172.50	174.81	8.	49.00	49.54	0.0	1028.00	1048.67	2.
26	174.81	177.13	6.	49.54	50.08	26.	1048.67	1069.33	3.
27	177.13	179.33	3.	50.08	50.62	0.0	1069.33	1090.00	1.
28	179.44	181.75	6.	50.62	51.17	0.0	1090.00	1110.67	6.
29	181.75	184.06	7.	51.17	51.71	0.0	1110.67	1131.33	2.
30	184.06	186.38	3.	51.71	52.25	16.	1131.33	1152.00	2.
31	186.38	188.69	6.	52.25	52.79	0.0	1152 00	1172.67	3.
32	188.69	191.00	1.	52.79	53.33	0.0	1172.67	1193.33	2.
33	191.00	193.31	5.	53.33	53.87	0.0	1193.33	1214.00	2.
34	193.31	195.62	3.	53.87	54.42	21.	1214.00	1234.67	2.
35	195.62	197.94	5.	54.42	54.96	0.0	1234.67	1255.33	0.0
36	197.94	200.25	6.	54.96	55.50	0.0	1255.33	1276.00	0.0
37	200.25	202.56	1.	55.50	56.04	10.	1276.00	1296.67	0.0
38	202.56	204.87	1.	56.04	56.58	0.0	1296.67	1317.33	0.0
39	204.87	207.19	2.	56.58	57.12	0.0	1317.33	1338.00	0.0
40	207.19	209.50	2.	57.12	57.67	0.0	1338.00	1358.67	1.
41	209.50	211.81	0.0	56.67	58.21	10.	1358.67	1379.33	0.0
42	211.81	214.12	0.0	58.21	58.75	0.0	1379.33	1400.00	1.
43	214.12	216.44	0.0	58.75	59.29	0.0	1400.00	1420.67	0.0
44	216.44	218.75	0.0	59.29	59.83	0.0	1420.67	1441.33	0.0
45	218.75	221.06	0.0	59.83	60.37	1.	1441.33	1462.00	0.0
46	221.06	223.37	0.0	60.37	60.92	0.0	1462.00	1482.67	0.0
47	223.37	225.69	0.0	60.92	61.46	0.0	1482.67	1503.33	0.0
48	225.69	228.00	0.0	61.46	62.00	0.0	1503.33	1524.00	0.0
49	228.00	230.31	1.	62.00	62.54	4.	1524.00	1544.67	1.
50	230.31	232.62	0.0	62.54	63.08	0.0	1544.67	1565.33	0.0
	Skewness = -0.081			Skewness = -0.399			Skewness = 0.468		
	Kurtosis = 1.407			Kurtosis = 0.969			Kurtosis = 0.484		

APPENDIX E

PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENTS

TABLE XXIX

PEARSON CORRELATION COEFFICIENTS BETWEEN EVENTS

THIRTEEN YEAR OLD BOYS

	1	2	3	4	5	6
1	1.000	-0.373	0.677	-0.631	-0.555	-0.278
2	-0.373	1.000	-0.564	0.560	0.501	0.662
3	0.677	-0.564	1.000	-0.813	-0.574	-0.388
4	-0.631	0.560	-0.813	1.000	0.634	0.450
5	-0.555	0.501	-0.574	0.634	1.000	0.349
6	-0.278	0.662	-0.388	0.450	0.349	1.000

FOURTEEN YEAR OLD BOYS

	1	2	3	4	5	6
1	1.000	-0.396	0.633	-0.580	-0.542	-0.371
2	-0.396	1.000	-0.530	0.568	0.557	0.615
3	0.633	-0.530	1.000	-0.662	-0.555	-0.432
4	-0.580	0.568	-0.662	1.000	0.630	0.429
5	-0.542	0.557	-0.555	0.630	1.000	0.454
6	-0.371	0.615	-0.432	0.429	0.454	1.000

FIFTEEN YEAR OLD BOYS

	1	2	3	4	5	6
1	1.000	-0.346	0.479	-0.458	-0.449	-0.320
2	-0.346	1.000	-0.507	0.601	0.541	0.542
3	0.479	-0.507	1.000	-0.640	-0.540	-0.374
4	-0.458	0.601	-0.640	1.000	0.651	0.427
5	-0.449	0.541	-0.540	0.651	1.000	0.390
6	-0.320	0.542	-0.374	0.427	0.390	1.000

Key: 1) 880 Yards; 2) Shut Put; 3) 100 Yards; 4) Long Jump; 5) High Jump; 6) Discus Throw.

TABLE XXX

PEARSON CORRELATION COEFFICIENTS BETWEEN EVENTS

SIXTEEN YEAR OLD BOYS

	1	2	3	4	5	6
1	1.000	-0.198	0.495	-0.467	-0.359	-0.199
2	-0.198	1.000	-0.401	0.495	0.471	0.571
3	0.495	-0.401	1.000	-0.601	-0.508	-0.329
4	-0.467	0.495	-0.601	1.000	0.581	0.445
5	-0.359	0.471	-0.508	0.581	1.000	0.394
6	-0.199	0.571	-0.329	0.445	0.394	1.000

SEVENTEEN YEAR OLD BOYS

	1	2	3	4	5	6
1	1.000	-0.211	0.388	-0.388	-0.349	-0.289
2	-0.211	1.000	-0.415	0.491	0.333	0.479
3	0.388	-0.415	1.000	-0.524	-0.493	-0.297
4	-0.388	0.491	-0.524	1.000	0.546	0.429
5	-0.349	0.333	-0.493	0.546	1.000	0.327
6	-0.289	0.479	-0.297	0.429	0.327	1.000

EIGHTEEN YEAR OLD BOYS

	1	2	3	4	5	6
1	1.000	-0.108	0.249	-0.387	-0.193	-0.149
2	-0.108	1.000	-0.381	0.371	0.267	0.452
3	0.249	-0.381	1.000	-0.617	-0.412	-0.281
4	-0.387	0.371	-0.617	1.000	0.474	0.220
5	-0.193	0.267	-0.412	0.474	1.000	0.126
6	-0.149	0.452	-0.281	0.220	0.126	1.000

Key: 1) 880 Yards; 2) Shot Put; 3) 100 Yards;
4) Long Jump; 5) High Jump; 6) Discus Throw.